SOILS, VEGETATION AND AGRICULTURE
TECHNICAL REPORT
VOLUME I
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For Amoco CO_2 Projects
Environmental Impact Statement

Prepared For:

U.S. Department of the Interior
Bureau of Land Management

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INTRODUCTION

The purpose of this technical report is to support the analysis of potential impacts on soils, vegetation and agriculture discussed in the Amoco CO_2 Supply Project Environmental Impact Statement (EIS). The EIS analyzes the potential impacts associated with construction, operation, maintenance and abandonment of five separate and distinct projects which would be located in Lincoln, Sweetwater, Fremont, Natrona, Hot Springs, Washakie, Big Horn and Park Counties, Wyoming and Carbon County, Montana. The approximate locations of major project components are shown on Figure 1-1. Chapter 2 of the EIS includes a detailed description of Amoco's Proposed Actions.

Construction of the five projects would occur between the second quarter of 1989 and the end of 1997. The first project proposed by Amoco is the Fontenelle CO_2 Supply Project which would be constructed in Lincoln and Sweetwater Counties. The Fontenelle Project is designed to provide a reliable source of CO_2 for enhanced oil recovery. The four remaining projects (Elk Basin CO_2 Project, Beaver Creek CO_2 Project, Little Buffalo Basin CO_2 Project and Salt Creek CO_2 Project) involve the injection of CO_2 into existing oil fields to increase ultimate oil recovery and extend the lives of the fields. To flood the existing fields with CO_2, Amoco would be required to 1) construct 16- or 18-inch supply pipelines to transport 150 to 200 million standard cubic feet per day (MMSCFD) of CO_2 from the Fontenelle Supply Source to the existing fields, 2) construct CO_2 recycle plants within each field to process field-produced gas for recycle and 3) replace some existing field facilities (wellheads, production flowlines and injection system) to accommodate CO_2 injection and higher pressure production from the fields.

The scope of the EIS is primarily restricted to analyzing the impacts associated with CO_2 spur and trunk pipelines and the proposed gas processing and CO_2 recycle plants. Precise plans and locations for wellfield-related activities are not available at this time. Analysis and mitigation of specific impacts associated with individual wellfield-related activities will be conducted after preparation of field development plans.

Table 1.1 summarizes the acreage which will be disturbed and reclaimed during construction and operation of the proposed actions. The acreage calculations assume disturbance of 75-foot-wide spur and trunk pipeline corridors, 40 acres of new disturbance for the gas processing plant and each recycle plant, and miscellaneous acreage for block valves, origin and meter stations and staging areas for road, canal and river crossings. Construction of the majority of spur and trunk pipelines would occur in existing pipeline corridors. Table 1.2 summarizes the estimated disturbance for replacing existing field facilities. The estimate for wellfield-related disturbance assumes complete replacement of all production and injection pipelines in each field. In fact, however, it may be necessary to replace pipelines in only portions of certain fields. In other fields, existing pipelines may be adequate and no new construction may be necessary.

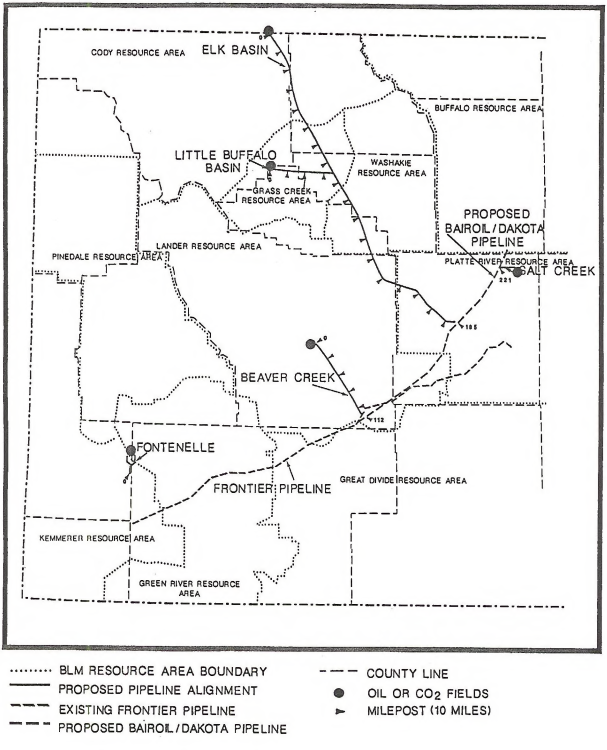

Figure 1—1. Location of Proposed Pipeline Alignments.

Table 1-1. Acres Disturbed, Removed and Reclaimed During Construction and Operation of the Proposed Actions.

Project/Component	Acres Disturbed During Construction	Acres Reclaimed After Construction	Acres Committed To Operations	Acres Reclaimed After Abandonment
FONTENELLE PROJECT				
Plant Site	40.0	0.0	40.0	40.0
Plant Access Road (a)	18.2	0.0	18.2	18.2
Field Access Roads (b)	181.8	0.0	181.8	181.8
Well Pads (c)	100.0	90.0	10.0	10.0
Gas Gathering System (d)				
Pipeline (d) (e)	491.4	491.4	0.0	0.0
Block Valves (f) (g)	0.2	0.0	0.2	0.2
Green River Staging Area (h)	2.3	2.3	0.0	0.0
Road Crossing Bore Pits (i)	2.3	2.3	0.0	0.0
Gathering System Subtotal	496.2	496.0	0.2	0.2
Project Total	836.2	586.0	250.2	250.2
ELK BASIN PROJECT				
Trunk Pipeline				
Trunk Pipeline (e)	1623.5	1623.5	0.0	0.0
Block Valves (g)	0.9	0.0	0.9	0.9
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Big Horn River Staging Area (j)	2.3	2.3	0.0	0.0
Greybull River Staging Area (j)	2.3	2.3	0.0	0.0
Shoshone River Staging Area (j)	2.3	2.3	0.0	0.0
Sidon Canal Bore Pit (k)	1.1	1.1	0.0	0.0
Road Crossing Bore Pits (i)	5.7	5.7	0.0	0.0
Pipeline Subtotal	1638.5	1637.3	1.2	1.2
Plant Site	40.0	0.0	40.0	40.0
Project Total	1678.5	1637.3	41.2	41.2
BEAVER CREEK PROJECT				
Trunk Pipeline				
Trunk Pipeline (e)	399.9	399.9	0.0	0.0
Block Valves (g)	0.2	0.0	0.2	0.2
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Sweetwater River Staging Area (j)	2.3	2.3	0.0	0.0
Road Crossing Bore Pits (i)	2.3	2.3	0.0	0.0
Pipeline Subtotal	404.9	404.4	0.5	0.5
Plant Site	40.0	0.0	40.0	40.0
Project Total	444.9	404.4	40.5	40.5

Table 1-1. Continued.

Project/Component	Acres Disturbed During Construction	Acres Reclaimed After Construction	Acres Committed To Operations	Acres Reclaimed After Abandonment
LITTLE BUFFALO BASIN PROJECT				
Spur Pipeline				
Spur Pipeline (e)	322.6	322.6	0.0	0.0
Block Valves (g)	0.2	0.0	0.2	0.2
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Road Crossing Bore Pits (i)	3.4	3.4	0.0	0.0
Pipeline Subtotal	326.5	326.0	0.5	0.5
Plant Site	40.0	0.0	40.0	40.0
Project Total	366.5	326.0	40.5	40.5
SALT CREEK PROJECT				
Spur Pipeline				
Spur Pipeline (e)	84.1	84.1	0.0	0.0
Block Valves (g)	0.1	0.0	0.1	0.1
Origin Station	0.1	0.0	0.1	0.1
Meter Station	0.2	0.0	0.2	0.2
Road Crossing Bore Pits (i)	1.1	1.1	0.0	0.0
Pipeline Subtotal	85.6	85.2	0.4	0.4
Plant Site	40.0	0.0	40.0	40.0
Project Total	125.6	85.2	40.4	40.4
Total of all five Projects	3451.6	3039.0	412.6	412.6

a = 3 miles of access road @ 50'.
b = Assumes 3 miles of access road/well @ 50'.
c = 10 wells @ 10 acres/well for drilling purposes and 1 acre/well during operations.
d = Assumes 3 miles of gathering system/well plus gas gathering trunkline to plant.
e = Assumes 75' right-of-way.
f = Includes block valves on each side of Green River crossing.
g = Block valves would occupy 1/10 acre.
h = 200' x 400' less pipeline right-of-way on each side of river.
i = 200' x 200' less pipeline right-of-way on each side of state highway crossings.
j = 200' x 400' less pipeline right-of-way on each side of river.
k = 200' x 200' less pipeline right-of-way on each side of canal.

Table 1-2. Estimated Miles of Existing Producing and Injection Pipelines and Numbers of Producing and Injection Wells in the Fields Targeted for CO2 Flooding.

Field	Miles of Pipeline		Wells		Acres Disturbed (a)
	Producing	Injection	Producing	Injection	
Elk Basin	75	45	90	73	682.5
Beaver Creek	25	28	29	28	254.B
Little Buffalo Basin	90	65	176	40	819.0
Salt Creek	195	182	1000	700	1774.5
Total	385	320	1295	841	3530.8

a = Average disturbed if all existing pipeline is replaced; assumes a common trench 75' wide; no new disturbance expected for wells.

Table 1-3. Proposed Construction Schedule for Major Components of the Amoco Carbon Dioxide Projects.

Project	Trunk and Spur Pipelines		Plants		Wellfield-Related Activities		Initiate Carbon Dioxide Injection
	Start	Complete	Start	Complete	Start	Complete	
Fontenelle Project	N/A		2nd Qtr 1989	4th Qtr 1990	2nd Qtr 1989	3rd Qtr 1990	N/A
Elk Basin Project	2nd Qtr 1990	4th Qtr 1990	2nd Qtr 1990	3rd Qtr 1991	2nd Qtr 1989	4th Qtr 1990	4th Qtr 1990
Beaver Creek Project	2nd Qtr 1992	3rd Qtr 1992	1st Qtr 1992	2nd Qtr 1993	2nd Qtr 1991	4th Qtr 1992	3rd Qtr 1992
Little Buffalo Basin Project	2nd Qtr 1993	3rd Qtr 1993	1st Qtr 1993	2nd Qtr 1994	2nd Qtr 1992	3rd Qtr 1993	3rd Qtr 1993
Salt Creek Project	2nd Qtr 1994	3rd Qtr 1994	4th Qtr 1993	4th Qtr 1994	4th Qtr 1993	4th Qtr 1997	4th Qtr 1994

Table 1-3 is the proposed construction schedule. All trunk and spur pipelines would be completed during a single construction season starting in the spring of a given year with completion scheduled for year's end. No vehicular travel or equipment operation would take place during periods of high soil moisture conditions when the surface cannot support equipment or vehicles without causing excessive damage to the soils, and travel would be restricted to existing rights-of-way, roads and jeep trails. Periodic use of the right-of-way would be necessary for maintenance and operations.

Pipelines will be laid in a continuous spread, as illustrated in Figures 1-2 and 1-3 and described in detail in Chapter 2 of the EIS. For the analysis of impacts, it is assumed, unless otherwise stated, that the entire 75' right-of-way would be cleared of vegetation and graded to provide a safe working surface, pipe would be buried a minimum of three feet from the top of the pipe, topsoil would be segregated from subsoil and all short-term disturbance identified in Table 1-1 would be revegetated in the fall of the year of construction. Permittees and other regular users of public lands along the right-of-way would be notified in advance, with signs and other means, of construction activities that could affect their business or operations. Landowners would be notified by mail.

All 1:24,000 scale maps referenced in this technical report (i.e., Soils Maps and Vegetation Maps EB-1 through EB-40, BC-1 through BC-10, LBB-1a through LBB-10, SC-1 through SC-5 and F-1 through F-3) are available for review at BLM Resource Area offices in the project areas.

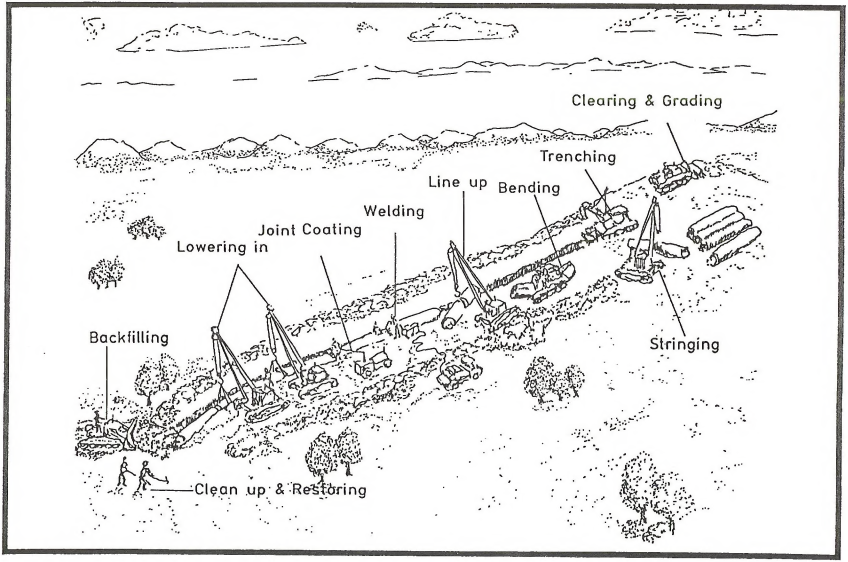

Figure 1—2. Pipeline Construction Spread.

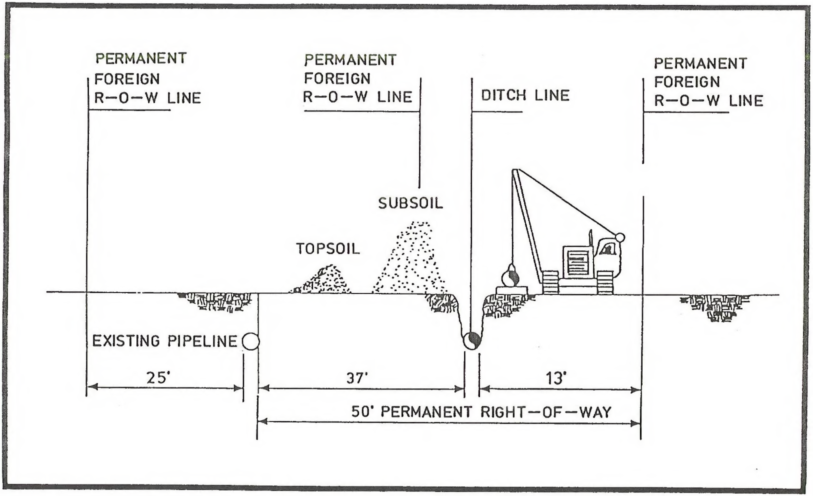

Figure 1—3. Amoco's Proposed Right—of—Way Configuration for Spur and Trunk CO_2 Pipelines.

AMOCO CO_2 PROJECTS
SOILS, VEGETATION AND AGRICULTURE
TECHNICAL REPORT
CHAPTER TWO:
AFFECTED ENVIRONMENT

2.1 INTRODUCTION

2.1.1 Soils

Information on soils for the study area was obtained from a variety of sources including Soil Conservation Service (SCS) published and unpublished soil surveys, special reports and BLM files. Table 2-1 lists, by county, the sources used for each of the counties potentially affected by construction of the proposed actions. All data and maps, except for published information on Washakie County, Wyoming, and Carbon County, Montana, are draft or considered preliminary.

The distribution of general soils types is illustrated in Figure 2-1 and types are described by project in Section 2.2 through 2.6.

More detailed, Order 3 survey data are available for most of the study area and are mapped for the five fields and for one mile on either side of all spur and trunk pipeline centerlines (see Soil Maps EB-1 through 40, LBB-1a through 10, SC-1 through 5, BC-1 through 10 and F-1 through F-3). Data from all Order 3 survey soil units are summarized in the appropriate project sections and Appendices B, C and D. Information includes:

- Map symbols and soil unit names;
- Series' classifications;
- Engineering properties;
- Physical and chemical properties; and
- Soil and water features.

Soils that are particularly susceptible to impacts and that may be disturbed during construction of the projects are identified in Appendix A. These "fragile" soils have certain properties that may require special erosion control or revegetation efforts. Delineation of fragile soils was based on the following Bureau of Land Management (1985a) criteria:

- Shallow over bedrock (less than 20 inches);
- Underlain by hard bedrock;
- Sand, loamy sand and clay-textured surface and subsoil layers;
- Containing more than 35 percent coarse fragments by volume;
- Permeability less than 0.6 inche per hour;
- Water table less than 72 inches;
- Soil reaction with pH greater than 8.5, salinity more than 16 millimhos in the upper 40 inches; and
- Occupying slopes steeper than 15 percent.

While the <u>potential</u> for having a slope limitation is indicated on the county fragile soil unit tables (Table A-1 through A-8), Appendix A also includes Table A-9 which lists areas of pipeline routes identified as steep slopes. These milepost locations along each spur and trunk pipeline route were identified from 1:24,000 topographic maps. This table includes significant areas of steep

Table 2-1. Soils Data Sources Evaluated During Preparation of the Environmental Impact Statement.

County	Source	Data
Big Horn, Wy.	SCS State Office Powell, Lovell and Greybull SCS Offices	General County Soils Map Private property: Field aerial photographs unit descriptions form 5's
	Cody Resource Area Office	Public land: 1:24,000 Maps unit descriptions form 5's
Fremont, Wy.	Lander and Riverton SCS Office	General Soils Map of Wyoming 1:24,000 Maps working draft survey form 5's
	Lander Resource Area Office (Affinis, 1986a)	1:24,000 Maps draft soil properties Beaver Creek Baseline Studies
Hot Springs, Wy.	SCS State Office Powell and Thermopolis SCS Offices	General County Soils Map Private property: field aerial photographs unit descriptions form 5's
	Grass Creek Resource Area Office	Public land: 1:24,000 Maps unit descriptions
Lincoln, Wy.	SCS State Office Green River Resource Area Office	General County Soils Map 1:125,000 Maps reconnaissance survey unit names
	Rock Springs District Office	1:24,000 Maps report on selected soils (ERO, 1987)
Natrona, Wy.	SCS State Office Mills SCS Office	General County Soils Map SCS working draft survey
Park, Wy.	SCS State Office Powell SCS Office	General County Soils Map Private property: field aerial photographs unit descriptions form 5's
	Cody Resource Area Office	Public land: 1:24,000 Maps unit descriptions form 5's
	(Affinis, 1986b)	Elk Basin Baseline Studies

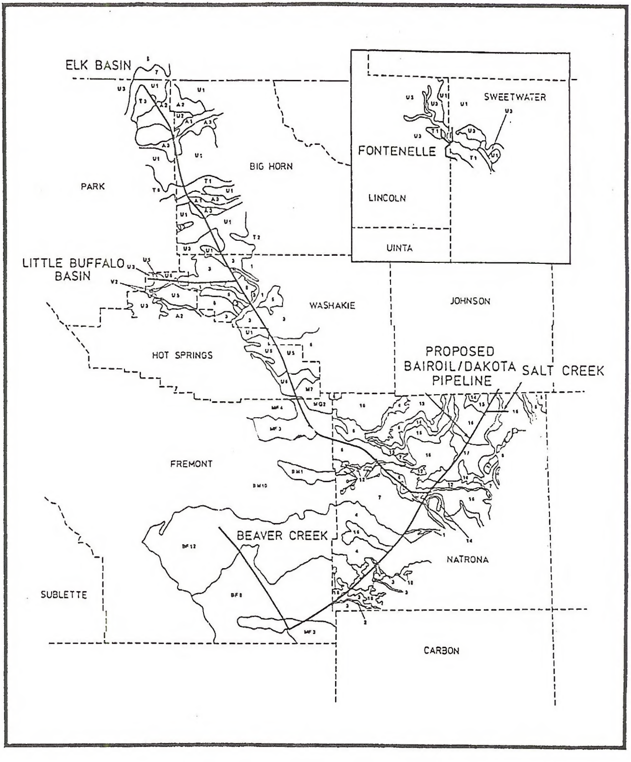

Figure 2—1. General Soil Types.

Figure 2-1. Legend for Map of General Soil Units of Project Counties.

Map Symbol	General Soil Unit
CARBON COUNTY, MONTANA:	
5	Midway - Travessila
7	Harvey - Stormitt
BIG HORN COUNTY, WYOMING:	
A1	Typic Fluvaquents, mesic - Typic Torriorthents, mesic - Typic Torrifluvents, mesic
A3	Typic Torrifluvents, mesic - Typic Natrargids, mesic
T1	Typic Haplargids, mesic
U1	Typic Torriorthents, mesic - Rock outcrop
FREMONT COUNTY, WYOMING:	
BF8	Torriorthents - Haplargids - Rock outcrop
BF12	Haplargid - Torriorthents
MF3	Haploborolls - Argiborolls - Rock outcrop
MF4	Haploborolls, shallow
BM10	Haplargids - Torriorthents
HOT SPRINGS COUNTY, WYOMING:	
F1	Ustic Torriorthents, frigid - Rock outcrop
M7	Rock outcrop - Argic Cryoborolls - Lithic Cryoborolls
U1	Typic Torriorthents, mesic shallow - Rock outcrop - Typic Torrifluvents, mesic
U3	Borollic Haplargids - Rock outcrop - Ustic Torriorthents, frigid
U6	Ustic Torriorthents, mesic - Rock outcrop
V2	Ustic Torriorthents, frigid, mesic
LINCOLN COUNTY, WYOMING:	
T1	Typic Calciorthids, frigid - Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Rock outcrop
U1	Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Typic Calciorthids, frigid - Rock outcrop
U3	Typic Torriorthents, frigid - Typic Calciorthids, frigid - Typic Torripsamments, frigid - Rock outcrop
V1	Ustic Torrifluvents, frigid - Fluvaquentic Halaquepts, frigid - Typic Cryaquolls, frigid - Typic Cryaquents, frigid - Riverwash
NATRONA COUNTY, WYOMING:	
1	Ustic Torrifluvents, mesic-Ustollic Natrargids, mesic
6	Ustic Torriorthents, mesic - Borollic Lithic, mixed - Rock outcrop
7	Ustollic Haplargids, mesic - Ustollic Natrargids, mesic-Ustic Torriorthents, mesic
8	Ustollic Haplargids, mesic - Ustic Torriorthents, mesic
9	Typic Haplargid, mesic - Typic Haplargids, mesic - Typic Torriorthents, mesic
12	Ustic Torripsamments, mesic - Ustollic Haplargids, mesic - Ustollic Haplargids, mesic
16	Typic Torriorthents, mesic - Ustollic Camborthids, mesic - Ustollic Natrargid, mesic
17	Ustollic Camborthids, mesic - Haplustollic Natrargid, mesic
PARK COUNTY, WYOMING:	
T3	Ustollic Haplargids - Ustic Torriorthents, mesic, shallow
T5	Typic Haplargids, mesic
U1	Typic Torriorthents, mesic - Rock outcrop
U2	Typic Torriorthents, mesic - Rock outcrop
SWEETWATER COUNTY, WYOMING:	
T1	Typic Calciorthids, frigid
U1	Typic Calciorthids, frigid - Typic Torriorthents, shallow
U3	Typic Torripsamments, frigid - Typic Natrargids, frigid - Typic Torriorthents, frigid, shallow
WASHAKIE COUNTY, WYOMING:	
1	Typic Torrifluvents, mesic
3	Typic Torriorthents, mesic - Rock outcrop - typic Torrifluvents, mesic
5	Typic Haplargids, mesic - Typic Natrargids, mesic
6	Ustic Torriorthents, mesic - Ustollic Haplargids, mesic

slopes (i.e., areas at least 0.1 mile long) but does not list small steep hills, incised drainages, etc.

At the Order 3 survey level, most of the soil mapping units are made up of two or more kinds of soil. A **soil complex** is a map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas. A **soil association** is a group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit (Soil Conservation Service, 1983b). The dominant soils of a complex or association and small inclusions in either of these units may differ substantially from one another. Identification of fragile soils (Appendix A) is based on the most limiting features of any soil of the complex or association but does not necessarily recognize more severe limitations of soil inclusions.

Soils which meet the criteria for prime farmland are listed by county in Table 2-2. Preliminary soil units of the study area which have not been formally designated as prime farmland units are listed only if all soils in the complex or association meet the prime farmland criteria.

This is consistent with farm management where associations and complexes are typically managed based on characteristics of the poorest soil in the unit.

2.1.2 Vegetation

2.1.2.1 Data Sources. Study area vegetation types were described and mapped using aerial photography interpretation (black and white still photographs, LANDSAT imagery and color video tape), Soil Conservation Service vegetation descriptions and range site delineations, BLM file and published maps and limited field verification. Each portion of the study area was mapped using the best available data for that area. Since the quality of available data varies between BLM Resource Areas and even within a particular Resource Area, the sources for mapping and the precision of mapping vary. Table 2-3 indicates the data, scale of maps and sources used to map each project area. While consistency in precision of baseline data presentation is possible, consistency would have required mapping at the lowest common denominator of quality of data (i.e., maps at a scale of 1:250,000) even though more detailed information exists for many areas.

Available data varied considerably in both scale and type of mapping. Existing maps range in scale from 1:250,000 to 1:24,000. While some BLM Resource Area offices have mapped vegetation types, others have mapped only range types. Range maps may not be very useful for delineating vegetation types which are not of value to livestock, e.g., a juniper woodland with sagebrush understory would typically be delineated as "sagebrush" on a range inventory map. Problems in interpretation also arise because different area offices have used a variety of names to delineate similar vegetation communities. Table 2-4 correlates vegetation type names used by the various data sources to the vegetation maps of this report. Tables in each project section include the vegetation types inferred from Soil Conservation Service soil unit descriptions and range sites.

2.1.2.2 Area Flora. The flora of the study area, which reflects the diversity of Wyoming itself, is a composite of several floristic elements, primarily the Rocky Mountain Element, the Great Plains/Prairie Element and the Great Basin Element. The state is not particularly rich in endemic plant species, although

Table 2-2. Soil Units Classified as Prime Farmland. (a)

Project	County	Symbol	Soil Unit
Fontenelle	Lincoln	413	Leckman fine sandy loam, 0-5% slopes
	Sweetwater	413	Leckman fine sandy loam, 0-5% slopes
Elk Basin	Park	P11A	Garland loam, 0-3% slopes
		P15A	Emblem loam, 0-3% slopes
		P42A	Apron sandy loam, 0-3% slopes
		P42B	Apron sandy loam, 3-6% slopes
		P43A	Youngston clay loam, 0-3% slopes
		P68A	Lostwells sandy clay loam, 0-3% slopes
		P93A	Olney sandy loam, 0-6% slopes
	Big Horn	BH1A	Glenton sandy loam, 0-3% slopes
		BH11A	Garland-Emblem clay loams, 0-3% slopes
		BH42A	Apron sandy loam, 0-3% slopes
		BH43A	Lostwells clay loam, 0-3% slopes
		BHD43A	Youngston clay loam, moderately wet, 0-3% slopes
		BH48A	Youngston clay loam, 0-3% slopes
	Washakie	2	Apron sandy loam, 0-3% slopes
		25	Glenton sandy loam, moderately wet
		40	Lostwells clay loam, 0-3% slopes
		41	Lostwells clay loam, 3-6% slopes
		81	Youngston clay loam, moderately wet, 0-3% slopes
		82	Youngston silty clay loam, 0-3% slopes
	Hot Springs	73	Tensleep loam, 0-3% slopes
		91	Neville loam, 0-3% slopes
	Fremont	none	
	Natrona	none	
Beaver Creek	Fremont	none	
Little Buffalo Basin	Hot Springs	none	
	Park	none	
	Washakie	40	Lostwells clay loam, 0-3% slopes
		41	Lostwells clay loam, 3-6% slopes
		81	Youngston clay loam, moderately wet, 0-3% slopes
		82	Youngston silty clay loam, 0-3% slopes
Salt Creek	Natrona	none	

a = Source: Soil Conservation Service, 1983a and Soil Conservation Service, 1983b.

Table 2-3. Data Sources for Vegetation Mapping.

Project	8LM Resource Area	Data Sources
Fontenelle	Kemmerer	1:250,000 vegetation map preliminary vegetation descriptions from BLM soil survey color video tape
	Green River	1:250,000 vegetation map preliminary vegetation descriptions from 8LM soil survey color video tape
Elk Basin	Cody	1:24,000 range sites maps for range/soils correlated survey vegetation typing SCS aerial photos SCS maps with range site descriptions "Elk Basin Baseline Data", (Affinis, 1986b) color video tape
	Grass Creek	1:250,000 ecological complex map SCS aerial photos SCS maps with range site descriptions color video tape
	Washakie	1:500,000 vegetation map SCS maps with range site descriptions color video tape
	Lander	1:24,000 LANDSAT land cover type maps 1:24,000 range type maps SCS maps with range site descriptions color video tape
	Platte River	1:250,000 range type maps 1958 resource inventory SCS maps with range site descriptions color video tape
Beaver Creek	Lander	1:24,000 LANDSAT land cover type maps 1:24,000 range type maps SCS maps with range site descriptions color video tape "Beaver Creek Baseline Data" Affinis, 1986a)
Little Buffalo Basin	Grass Creek	1:250,000 ecological complex map SCS maps with range site descriptions SCS aerial photographs color video tape
Salt Creek	Platte River	1:250,000 range type maps 1958 resource inventory SCS maps with range site descriptions color video tape

Table 2-4. Correlation of Mapped Vegetation Types to Original Data Sources.

Mapped Vegetation Type	Cody (a)	Grass Creek (b)	Washakie (c)	Lander (d)	Platte River (e)	Kemmerer (f)	Green River (g)	Beaver Creek (h)	Elk Basin (i)
Sagebrush/Grassland	Sagebrush/Grass Sagebrush	Sagebrush/Grass	Sagebrush/Grass	Sagebrush Sagebrush/Mixed Grass High Density Sagebrush Low Density Sagebrush	Sagebrush	Sagebrush	Sagebrush/Grass	Big Sagebrush Shrubland	Sagebrush Shrubland
Desert Shrub	Salt Shrub	Saltbush Shrub	Desert Shrub	Greasewood/Saltbush	Saltbush	Saltbush/Greasewood Low Density	Saltbush/Winterfat		Gardner Saltbush/ Birdsfoot Sage
Grassland	Grassland			Grass Mixed Grass/Sagebrush Low Density Grass	Grass	Grassland/Shrubland	Grass		
Mixed Shrub	Mixed Shrub			Sagebrush/Rocky Soils				Mixed Shrub	Skunkbrush Shrubland
Coniferous Woodland	Juniper		Juniper Woodlands	Juniper	Juniper	Sagebrush/Juniper Juniper		Mixed Shrub	Pine Woodland
Riparian	Riparian Greasewood	Riparian	Other Greasewood	Riparian Greasewood/Saltbush Riparian Grass/Sedge Willow/Cottonwood High Density Sagebrush/Greasewood	Meadow Greasewood	Cottonwood/Willow Cropland/Riparian Saltbush/Greasewood	Meadow Greasewood	Riparian Wyoming Sagebrush Shrubland Greasewood Shrubland Alluvial Sand	Riparian
Cropland		Cropland	Other	Fenced Private Hayland		Cropland/Riparian			
Barren/Badlands	Rock Outcrop	Barrens	Other	Waste Rock Outcrop	Barren Waste	Barren/Cultural Dist	Barren Waste	Rock Outcrop	
Disturbed				Barren/Mining/Urban				Disturbance	Disturbed Areas

a = Source: Cody Resource Area RMP (BLM, 1987a).
b = Source: Grass Creek Resource Area Grazing EIS (BLM, 1982b).
c = Source: Washakie Resource Area RMP DEIS (BLM, 1986c).
d = Source: Lander Resource Area Green Mountain Grazing DEIS (BLM, 1982b) and Gas Hill Grazing Supplement EIS (BLM, 1986a) and LANDSAT maps.
e = Source: Platte River Resource Area RMP DEIS (BLM, 1984a).
f = Source: Kemmerer Resource Area RMP DEIS (BLM, 1985b).
g = Source: Sandy Grazing EIS (BLM, 1978).
h = Source: Beaver Creek Baseline Studies (Affinis, 1986a).
i = Source: Elk Basin Baseline Studies, (Affinis, 1986b).

there are a few in the vicinity of the study area (Porter, 1962; Rocky Mountain Heritage Task Force, 1987).

Vegetation zones of Wyoming are generally correlated with altitude, although the demarcation between zones is not necessarily horizontal. If zonation is determined by any one factor, that factor is a complex one - energy with its elements of sunlight, thermal radiation, water, wind and nutrients (Porter, 1962). The major vegetation zones of the study area are Foothills Scrub, Grassland, Desert, and Basin and River Bottoms. These can be further subdivided into vegetation types.

2.1.2.3 <u>Vegetation Types</u>. The project area has been mapped as nine major vegetation types: Sagebrush/Grassland, Desert Shrub, Grassland, Mixed Shrub, Coniferous Woodland, Riparian, Cropland, Barrens/Badlands and Disturbed. Vegetation Maps EB-1 through EB-40, SC-1 through SC-5, LBB-1a through LBB-10, BC-1 through BC-10 and F-1 through F-3 illustrate the distribution of vegetation within field boundaries and within a two-mile-wide corridor along the centerlines of spur and trunk pipelines.

These maps illustrate the relative abundance of vegetation types within the study area. Sagebrush/Grassland and Desert Shrub types dominate the landscape. Conversely, Riparian and Cropland types represent a very small proportion of the study area. Since the latter are very valuable, both economically and to the natural ecosystem, it is important to assure that any impact on these types would be recognized, fully evaluated and adequately mitigated. The extent of these communities was, therefore, very conservatively delineated and may have been slightly exaggerated during mapping. For example, areas adjacent to cropland that could not be definitively designated as another vegetation type were mapped as cropland. Narrow ribbons of riparian vegetation may be designated as wider bands on the maps. In addition, the smallest measure used in the vegetation disturbance tables (Tables 2-13, 2-16, 2-19, 2-22 and 2-25) is 0.1 mile. The acreage of disturbed riparian vegetation is, consequently, exaggerated for all drainages less than 0.1 mile wide.

Potential vegetation production (pounds per acre) depends primarily on soils, elevation and precipitation which is reflected in Soil Conservation Service range sites. Table 2-5 summarizes potential production for the native vegetation types. Current production within study area vegetation communities depends to a great extent on grazing management and the resulting range condition.

<u>Sagebrush/Grassland</u>. The project areas are dominated by the Sagebrush/Grassland vegetation type occupying gently rolling topography. Sagebrush/Grassland vegetation can be found on a variety of soil types, topography and elevation. Within the community, composition varies with shrubs (constituting from 40 to 70 percent), grasses (30 to 60 percent) and forbs (a trace to about 10 percent). Soil Conservation Service designations of potential vegetation composition frequently indicate less shrub cover. A high percentage of shrub cover is indicative of range deterioration in many cases (BLM, 1987a) and probably means that the actual production is lower than the figures indicated in the production tables.

Wyoming big sagebrush usually dominates the vegetation type but Basin big sagebrush and Black sagebrush sub-types are also present. Wyoming big sage is the most widely distributed in the study area and is the most xeric member of the big sagebrush group. Black sage dominated areas are usually at higher elevations, often in the transition zone to mountain brush communities and seem

Table 2-5. Potential Vegetation Production for Project Vegetation Types. (a)

Symbol	Vegetation Type (b,c)	Range of Potential Production (pounds per acre) Unfavorable Years	Favorable Years	Normals
Fontenelle Supply Project				
S/G	Sagebrush/Grassland	200-350	450-700	350-500
DS	Desert Shrub	150-300	300-700	200-500
G	Grassland	200	450	350
R	Riparian	800	2000	1200
Elk Basin Project				
S/G	Sagebrush/Grassland	100-600	300-1400	200-1100
DS	Desert Shrub	85-350	250-700	150-500
G	Grassland	100-850	300-2000	200-1500
MX	Mixed Shrub	160-700	400-1200	300-900
CW	Coniferous Woodland	160-500	400-1100	300-700
R	Riparian	350-3000	800-6000	525-4500
C	Cropland	85-1400	250-2600	150-2400
Beaver Creek CO2 Project				
S/G	Sagebrush/Grassland	350-1200	700-2200	500-1800
DS	Desert Shrub	275	650	400
G	Grassland	300-1200	650-2400	450-1800
MX	Mixed Shrub	500-700	1000-1500	800-1200
CW	Coniferous Woodland	400-700	900-1200	650-900
R	Riparian	1200-2500	2500-3400	1800-3000
C	Cropland	700	1200-1500	700-1200
Little Buffalo Basin Project				
S/G	Sagebrush/Grassland	100-500	300-1100	200-800
DS	Desert Shrub	85-500	250-1100	150-800
G	Grassland	100-500	450-1100	
CW	Coniferous Woodland	350	700	
R	Riparian	600-1800	1200-2600	1000-2400
C	Cropland	200-1800	550-2600	350-2400
Salt Creek Project				
S/G	Sagebrush/Grassland	400-750	900-1800	700-1300
DS	Desert Shrub	200-500	400-900	300-700
G	Grassland	700	1200-1500	900-1200
R	Riparian	700-1200	1600-2500	1700-1800

a = Source: Compiled from Soil Conservation Service range site descriptions (Soil Conservation Service, 1986).
b = Barren/Badlands are not included because the Soil Conservation Service does not generally rate them for production.
c = Disturbed areas are not included because their potential productivity may have been severely modified.

to have an affinity for calcareous soils with a lot of surface rock or pavement (Winward, 1980). Basin big sage is frequently found in more mesic valley bottom communities and may, therefore, also be mapped as a Riparian vegetation type. Many Basin big sage communities throughout the West have been converted to cropland (Winward and Tisdale, 1969).

Common grasses of the Sagebrush/Grassland type are Western wheatgrass, Thickspike wheatgrass, Indian ricegrass, Needle and thread, Green needlegrass, Bluebunch wheatgrass, Sandberg bluegrass, Idaho fescue and Threadleaf sedge. (BLM 1978; BLM 1982c; BLM 1986b; BLM, 1987a).

Sagebrush/Grassland communities in the project areas range in potential production from a low of 100 pounds per acre in unfavorable years in the 5- to 9-inch precipitation zone of the Big Horn Basin to 2,200 pounds per acre in favorable years in the 15- to 19-inch precipitation areas of southeastern Fremont County (Table 2-5) (Foothills and Mountains Southeast Range Site) (Soil Conservation Service, 1986). A range of 225 to 600 pounds per acre is more typical of Sagebrush/Grassland communities. The high of 2,200 pounds per acre may be found in essentially grassland communities with a 5 to 10 percent shrub component.

Desert Shrub. The Desert Shrub type is a low stature, low density shrub dominated type characteristic of the more alkaline soils of the area. Total plant cover may average as little as 10 percent. Gardner saltbush is the most common dominant although Nuttall saltbush, Birdsfoot sage, Shadscale or Fourwing saltbush may be co-dominants or may dominate subtypes depending on soils, management and other factors (BLM, 1978; Affinis, 1986b; BLM, 1982c; BLM, 1986b; BLM, 1987a). Shrubs may constitute as much as 90 percent of total cover (BLM, 1982a), although the potential composition of Desert Shrub communities (e.g., saline upland, impervious clay or shale range sites) is about 40 to 50 percent grasses, 10 percent forbs and 40 to 50 percent shrubs (Big Horn and Wind River Basins 5- to 9-inch Range Sites) (Soil Conservation Service, 1986).

Other common shrubs of the Desert Shrub vegetation type are Spiny hopsage, Spineless horsebrush, Bud sagebrush, Winterfat and Greasewood. Understory species include, Bottlebrush squirreltail, Indian ricegrass, Thickspike wheatgrass, Needlegrass and Western wheatgrass.

Production of Desert Shrub communities ranges from 85 pounds per acre in unfavorable years in the 5- to 9-inch precipitation zone of the Big Horn Basin to 1,100 pounds per acre in favorable years in the 10- to 14-inch precipitation zone of north central Wyoming (Table 2-5) (Foothills and Basins East Range Site Zone) (Soil Conservation Service, 1986)

Grassland. This primarily herbaceous type occurs on level to rolling topography. The dominant grass species include Bluebunch wheatgrass, Western wheatgrass, Indian ricegrass, Blue grama, Buffalo grass, Sideoat grama, Needlegrass, Sandberg bluegrass, June grass and Idaho fescue. Common forb species include Yarrow, Phlox, Buckwheat, Golden aster, Blazing star, Prickly pear cactus, Locoweed and Goldenrod (BLM, 1986b; BLM, 1985a; Kaul, 1986). Overgrazed Grasslands often deteriorate to shrub-dominated communities or form a mosaic with the Sagebrush/Grassland types (BLM, 1987a). Therefore, areas classified as Grassland may include areas dominated by sagebrush.

Grassland production ranges from 100 pounds per acre in unfavorable years in the 5- to 9-inch precipitation zone of the Big Horn Basin to 2,400 in favorable years in the 15- to 19-inch precipitation areas of southeastern Fremont County

(Table 2-5) (Foothills and Mountains Southeast Area) (Soil Conservation Service, 1986).

Mixed Shrub. The Mixed Shrub type includes a variety of shrub-dominated communities which are either so heterogeneous that they cannot be categorized within the other types or are composed of an intricate mosaic of other types. Many of the shrubs of this type also occur as dominates or codominates of other types, including Big sagebrush, Shadscale, Gardner saltbush, Rubber rabbitbrush, Greasewood, Horsebrush and Spiny hopsage. Shrubs of this type which are not common constituents of other types are Skunkbrush sumac and Fringed sage.

The Mixed Shrub type is used primarily to delineate sparsely vegetated shrublands of moderate to steep slopes. Soils are generally thin and/or rocky. This type has not been used to denote dense, mixed shrub bottomlands. The latter have been classified as Riparian or Sagebrush/Grassland, as appropriate.

Potential production for areas designated as Mixed Shrub range from 160 to 700 pounds per acre in unfavorable years and 400 to 1,200 pounds per acre in favorable years (Table 2-5). The higher production values for the Mixed Shrub type represent production for soil complexes which include both rock outcrops and more productive soils. Since rock outcrops are not rated for potential production, productivity of the Mixed Shrub type is exaggerated.

Coniferous Woodland. Tree density within a Coniferous Woodland may vary from a few scattered trees on rocky outcrops to true dominance by the species in large forests. Within the study area, Coniferous Woodlands are limited to scattered trees on moderate to steep slopes with shallow and rocky soils. The study area does not include any stands of harvestable timber. Overstory species include both Utah and Rocky Mountain Juniper, Limber pine and an occasional Pinyon pine. Common understory species are Big sagebrush, Rabbitbrush, Western wheatgrass, Bottlebrush squirreltail, Indian ricegrass, Bluebunch wheatgrass, Prairie junegrass and Needle and thread grass (BLM, 1985a; BLM, 1987a).

Production of Coniferous Woodlands is usually low due to poor soils and steep slopes. Soil Conservation Service range site production estimates do not include soils designated as "rock outcrop." Since this is a common habitat for the Coniferous Woodlands of the study area, production data are limited for this type. Other soil associations mapped as Coniferous Woodland range in production from 160 pounds per acre in poor years to 1,200 pounds per acre in favorable years with an average of 300 to 900 pounds per acre (Table 2-5). The lower production values more accurately represent this vegetation type. Higher values include soil associations or complexes in which the Coniferous Woodland type may occupy only the poorest sites.

Riparian. The Riparian type is one of the most limited in extent, yet the most diverse within the study area. In general terms, Riparian areas are "the green zones along the banks of rivers and streams and around springs, bogs, wet meadows, lakes and ponds" (BLM, 1987b). The Riparian type is not intended to correspond to the more limited regulatory definition of "wetland" employed by the U.S. Army Corp of Engineers.

The Riparian type occupies flat to gently sloping bottomlands and terraces in a variety of soil types. Whether the adjacent water body is perennial, intermittent or ephemeral, riparian vegetation is influenced by it during at least part of the growing season. The influence may be direct, e.g., by periodic flooding, or indirect, e.g., from a high water table such as in a subirrigated meadow or a Greasewood bosque. Despite their relatively

homogeneous topography, Riparian communities are characterized by both temporal and spacial variation in vegetation in response to changes in amount and quality of water. All or part of a Riparian community may be wet with fresh or saline water for various portions of the growing season.

Both wide (e.g., the Shoshone River) and narrow (e.g., Beaver Creek in the Beaver Creek Field) Riparian areas are frequently characterized by bands or zones of different vegetation. Changes in available water which create much of this zonation may be influenced by slight changes in elevation, distance from the water body or the influence of soil texture (porosity) on available water. For most of the project areas, the Riparian zone has been mapped as one unit and described as a mosaic of several communities. Where more detailed mapping and field checking have been completed, riparian sub-types are designated (Affinis, 1986a). For example, in the Beaver Creek Field Riparian subtypes of Tree-shrub-forb mosaic (R(F)), Greasewood (R(GW)), Basin big sagebrush (R(S)) and alluvial sand (R(A)) have been mapped in addition to the undifferentiated Riparian type (R).

The Riparian type includes tree, shrub and herb-dominated communities. Common tree dominants are Cottonwood, Hawthorn, Russian olive, Water birch or Peachleaf willow. Shrub-dominated communities usually include a variety of genera and species including willows, tamarisk, dogwood, chokecherry, gooseberry, Big sagebrush, Rubber rabbitbrush or Greasewood. Graminoids may include many upland species from adjacent communities plus more water and/or salt tolerant species such as Inland saltgrass, Alkali cordgrass, Tufted hairgrass, Alkali sacaton, Basin wildrye, Baltic rush, and Nebraska, Inland and Golden sedge. Forbs may be common but are not usually dominant (BLM, 1985b; BLM, 1986b; Windell, 1986).

Much of Wyoming's natural riparian habitat has been modified by agriculture, both grazing and cropland. Poorly managed grazing in Riparian zones has degraded many of these areas to poor or fair ecological condition (BLM, 1987a) yielding less than their potential production. Potential production ranges from 600 pounds per acre in unfavorable years in a Greasewood, Alkali sacaton and Basin wildrye community (saline lowland range site in a 10- to 14-inch precipitation zone) to 3,400 pounds per acre in a wetter saline area in the same precipitation zone (saline subirrigated range site, High Plains Southeast Area) (Soil Conservation Service, 1986). In non-saline soils, production in riparian areas can range from 1,400 to 2,400 pounds per acre to 3,000 to 6,000 pounds per acre (lowland and wetland range sites, respectively, Big Horn 5- to 9-inch precipitation area) (Soil Conservation Services, 1986). Very low riparian area production (350 - 800 pounds per acre) is occasionally found in bedrock-controlled streams or very sandy bottomed creeks.

Cropland. Cropland includes both irrigated and non-irrigated row and forage crops including managed pastures. Common crops of the study area include sugar beets, alfalfa, corn, wheat and native grass pasture. This type does not include open range grazing land even if it is privately owned. See Section 2.1.3 for a more detailed discussion of Cropland of the study area.

The distinction between the Riparian type and Cropland is not always clear, particularly in bottomlands along the streams. For example, subirrigated native grass meadowland (an herbaceous Riparian type) is probably cut for hay or used to pasture livestock. While the types may be interchangeable in small areas, bottomland fields cut for hay are generally designated as Cropland and grazed meadows and fields interspersed with willows or cottonwoods are generally mapped as Riparian.

Table 2-5 lists the wide range of potential productivity of native plant communities on soil units which have been converted to cropland. These areas include naturally productive riparian areas which are not moisture limited and will produce 1,800 to 2,600 pounds per acre of native vegetation. Crops are also grown in areas which were native Desert Shrub vegetation. The potential production of the latter may be very low due to lack of water (e.g., 85 to 250 pounds per acre, shale range site in 5- to 9- inch precipitation areas; Big Horn Basin area) (Soil Conservation Service, 1986). With irrigation, these soils can be productive cropland.

Barren/Badlands. The Barren/Badlands designation is more properly a "landform" or "cover" type rather than a "vegetation" type, but it has traditionally been used to designate areas of extremely sparse vegetation and/or steep, highly erodible terrain. This designation includes Soil Conservation Service soils delineated as "Badlands" or "Rock outcrop" unless another vegetation type, typically Coniferous Woodland or Desert Shrub, could reasonably be assigned to the area. Many badlands areas support a very sparse saltbush community, but retention of the Barren/Badlands type serves to distinguish between productive Gardner Saltbush (Desert Shrub) communities on gentle to moderately sloping topography and the sparse, relatively unproductive communities of steep, erodible slopes.

Disturbed. Small areas of disturbance, e.g., roads, houses, corrals, utility lines, existing pipelines, etc. are included in all of the other designated vegetation types. Significant areas of manmade disturbance, e.g., industrial facilities and cities, are specifically delineated as Disturbed.

2.1.2.4 Plants of Special Interest. Although no federally threatened, endangered or proposed plants occur in the vicinity of project components, several taxa of special interest have been identified as occurring or potentially occurring in the vicinity of several projects. Taxa were identified either by the proximity of known occurrences of populations to the project area or by existence of suitable habitat in the project area. The Wyoming Department of Environmental Quality--Land Quality Division, the Wyoming office of the Rocky Mountain Heritage Task Force and the U.S. Fish and Wildlife Service (Wyoming State Office of Fish and Wildlife Enhancement) identified and provided location and habitat information on the taxa discussed below. Table 2-6 describes the federal categories and Wyoming Heritage ranks provided for each taxon.

2.1.2.5 Poisonous Plants and Noxious Weeds. Many poisonous plants are a natural constituent of the ecosystem and must be eaten in large quantities to be deadly. Several factors influence the degree of hazard posed by poisonous plants. These include seasonal susceptibility to the plant or portions of it, mineral deficiencies in the livestock's diet and large concentrations of poisonous plants in areas of limited forage availability (BLM, 1986a). A few plants, which may also be classified as noxious weeds, are opportunistic, introduced species and can become particular problems when the native community is disturbed. Halogeton is an example of a noxious and poisonous weed which invades disturbed areas (BLM, 1984a; BLM, 1985b; BLM, 1986a). It can be both dangerous to livestock and can inhibit successful revegetation. Table 2-7 lists the common poisonous plants and noxious weeds of the project areas.

2.1.3 Agriculture

According to the Wyoming Agricultural Statistics Service, "...agriculture has always been a major industry in Wyoming and its importance to the State's

Table 2-6. **Federal Categories and Wyoming Heritage Rankings for Plants of Special Interest.**

Category	Description
FEDERAL STATUS (a)	
LE	Formally listed as endangered.
PE	Proposed to be formally listed as endangered.
LT	Formally listed as threatened.
PT	Proposed to be listed as threatened.
1	Available data on biological vulnerability and threat(s) support listing but additional data are needed on precise habitat and/or critical habitat boundaries.
2	Available data indicates that listing may be appropriate but substantial data on vulnerability and threats are not available to support immediate listing.
3A	Probably extinct.
3B	Taxa does not meet the U.S. Fish and Wildlife Service definition of species; taxa may be re-evaluated in the future.
3C	Taxa that have proven to be more abundant or widespread than was previously believed and/or those that are not subject to any identifiable threat; further research may indicate re-evaluation to category 1 or 2.
WYOMING HERITAGE PROGRAM STATUS (b)	
G	Global rank.
S	State rank.
T	State rank for subspecies or varieties.
1	1 - 5 known occurrences: imperiled.
2	6 - 20 known occurrences.
3	21 - 100 known occurrences.
4	Greater than 100 but less than 1,000 occurrences.
5	Greater than 1,000 occurrences: demonstrably secure.

a = Source: Federal Register, 1985.
b = Source: Rocky Mountain Heritage Task Force, 1986.

Table 2-7. Common Poisonous Plants and Noxious Weeds of the Project Areas. (a)

Poisonous Plants	Habitat	Dangerous Season	Livestock at Risk
Arrowgrass	Wet and alkaline bottomlands	All	All, including horses
Chokecherry	Moist deep soils mostly in foothills	All	All, especially sheep
Cocklebur	Irrigated fields and wet places	Spring	All, especially cattle and pigs
Deathcamus	Foothills	Early spring	All, especially sheep
Greasewood	Alkaline bottomlands and washes	Spring	All, but mostly sheep
Halogeton	Disturbed sites, roads	Fall, Winter	All, but mostly sheep
Horsebrush	Mostly dry, semi-deserts	Spring	All, but mostly sheep
Horsetail	Irrigated fields and wet places	Haying season	All, especially cattle and horses
Larkspur	Foothills, deserts	Early spring	Cattle
Locoweed	Desert to mountains	All, especially spring	All
Lupine	Mountain foothills areas of deep soils	Most when in fruit	Sheep
Milkvetch	Desert to mountains	All, especially spring	All
Senecio	Desert to mountains	Spring and summer	All
Tansy mustard	Sandy alkaline soils	Summer	Cattle

Noxious Weeds	Habitat	Flowering Season	Problem
Canada thistle	Valleys to mid-montane; wet to mesic sites	Flowers July - Aug.	Can spread asexually
Musk thistle	Cropland, pasture, range, forest, roadsides and stream banks	Flowers June - Aug.	Spreads rapidly forming dense stands
Russian knapweed	Cultivated fields, pastures, orchards and roadsides	Flowers June - Sept.	Roots to 8 feet
Whitetop	Alkaline disturbed soils	Flowers early summer	Highly competitive

a = Source: BLM, 1986b; BLM, 1985b; Stoddart et al., 1975; James and Keller, 1980; Whitson, 1987.

economic stability will continue (Wyoming Agricultural Statistics Service, 1986)." In 1985, the last year for which data are available, total cash receipts from agriculture totaled almost $601 million. Eighty percent of these receipts came from marketing livestock and livestock products. Approximately 72 percent of the state is being used for livestock grazing, with beef cattle and sheep being the principal livestock raised. Table 2-8 summarizes cattle and sheep on ranches in the project counties. Project counties account for about 38 percent of cattle, calves and stock sheep on Wyoming ranches.

The major crop producing areas are southeastern Wyoming, the Wind River Basin and the Big Horn Basin. The latter is the location of the Little Buffalo Basin CO_2 Project and part of the Elk Basin CO_2 Project. Hay, barley, sugar beets, wheat, dry beans, corn and oats are important cash crops. Hay, corn and oats are grown primarily to support the livestock industry with some barley being sold for high-quality feed grain. The majority of barley is used in the brewing industry.

2.1.3.1 Livestock Grazing. Proposed pipelines, plants and wellfield-related facilities would disturb private grazing lands and state and federal lands authorized for grazing. Federal and most state grazing land is divided into allotments which may or may not contain private lands. Table 2-9 and tables within each project section indicate grazing allotments crossed by the pipelines and within field boundaries. Table 2-9 includes the category of allotment (i.e., I, M or C, described below), animal unit months (AUMs) licensed and their season of use.

Allotment categories have been designated for management purposes (BLM, 1986a). Category I (improve) allotments have one or more significant problems (e.g., range condition, conflicts with other grazing animals, lack of water, poor distribution of animals or other land uses that interfere with livestock) and currently have range management practices that will not resolve the problems. These allotments have a high productive potential and investment in range improvements are likely to result in sufficient returns to justify their cost.

Category M (maintenance) allotments have no significant problems. They are satisfactory in terms of vegetative production, species composition, condition and utilization levels and current management. For the most part, these allotments do not need a great deal of range improvements. Compared to "I" allotments, increased productivity from improvements in "M" allotments would not justify their cost.

Category C (custodial) allotments lack potential for economic return on public investment. These allotments have little or no potential for vegetative improvement because production potential is low or the area is in such poor condition that improvement is infeasible. Land ownership patterns in the area may also make public investment in range improvements impractical. To be classified as "C", there can be no critical resource conflicts or public concerns in these allotments.

Most of the cattle operations are cow-calf operations where the calves are kept from 6 to 12 months and then sold. A few are retained for herd replacement (BLM, 1986a). Some operators run yearlings, selling calves a year later than the cow-calf operators. Sheep operators use both shed and range lambing practices. Most horses are raised for domestic use.

Table 2-8. 1986 Cattle and Sheep Statistics by Project and County. (a)

Project	County	Cattle and Calves on Ranches	Percentage of Wyoming Total	Stock Sheep on Ranches	Percentage of Wyoming Total
Fontenelle	Lincoln	49,000	3.7%	27,000	0
	Sweetwater	17,000	1.3%	27,500	3.8%
Elk Basin	Park	77,000	5.8%	14,000	1.9%
	Big Horn	51,000	3.8%	41,000	5.7%
	Washakie	46,000	3.5%	44,000	6.1%
	Hot Springs	34,000	2.6%	12,000	1.7%
	Fremont	84,000	6.3%	33,000	4.6%
	Natrona	48,000	3.6%	75,200	10.4%
Beaver Creek	Fremont	84,000	6.3%	33,000	4.6%
Little Buffalo Basin	Park	77,000	5.8%	14,000	1.9%
	Hot Springs	34,000	2.6%	12,000	1.7%
	Washakie	46,000	3.5%	44,000	6.1%
Salt Creek	Natrona	48,000	3.6%	75,200	10.4%
All Project Counties		1,325,000	100.0%	720,000	38.0%

a = Source: Wyoming Agricultural Statistics, 1986; most recent published data.
1986 figures are preliminary.

Table 2-9. **Forage Statistics by Project and Resource Area.**

Project	Resource Area	Allotment Number	Category (a)	Acres (b)	Licensed AUMs (c)	Average AUMs Per Acre	Kind of Livestock (d)	Season of Use
Fontenelle	Kemmerer (e)	1112		12,555	1,272	0.10	C	7/1-9/20
							S	5/15-12/31
		1113		271,170	11,493	0.04	C	5/8-10/31; 5/16-9/30;
								6/1-9/30
							S	4/26-11/30; 5/1-5/31
								6/1-7/15; 5/20-7/15
								9/29-10/9; 6/26-6/28
		1306		257,313	30,924	0.12	S	12/1-11/30
							C	5/1-10/31
	Green River (f)	18 Mile		247,314	3,564	0.08	C	5/16-9/30; 10/1-12/15
					15,430		S	5/1-5/5; 10/1-12/14
		Lombard		94,802	1,501	0.07	C,H	5/1-1/31
					5,143		S	5/1-1/31 + trailing
Elk Basin	Cody (g,h)	0666	M	6,640	755	0.11	C,S	4/15-5/30
		1003	M	19,397	1,143	0.10	C	5/1-12/30
		1060	I	56,849	3,885	0.07	S	4/10-6/14;6/1-6/30
								10/1-12/18
							C	4/10-5/31
		1061	C	5,842	200	0.03	C	5/15-9/30
		1080	I	54,600	4,463	0.08	C	4/30-6/30; 11/1-2/6
		1086	M	4,775	309	0.06	S	3/5-5/15; 9/1-11/1
	Grass Creek (i)	0508	I	124,727	7,271	0.06	C	4/16-1/21
							S	11/1-9/15
		0509	I	96,203	7,663	0.08	C	5/1-10/31
							S	5/5-6/20; 10/10-2/19
		0512	C	11,793	726	0.06	C	5/1-9/30
		0549	C	327	27	0.08	S	6/1-6/10
		0674	C	11,270	1,092	0.10	S	5/10-7/9; 11/1-2/2
	Washakie (h,j)	0048	I	24,460	2,075	0.08	C	11/22-4/15
							S	11/15-3/14
		0501	I	15,084	2,957	0.20	S	1/1-6/10
							C	3/1-10/15
		0562	I	11,641	1,934	0.17	C	4/1-5/31; 11/5-12/13
		0571	I	4,071	503	0.12	C	10/20-12/31
		0591	I	5,027	476	0.09	S	10/21-1/22
		0603	C	2,280	431	0.19	C	11/1-12/30
		2513	I	242	30	0.12	N.D.	N.D. (k)
		2514	I	8,756	473	0.05	N.D.	N.D.
		2542	I	440	96	0.22	N.D.	N.D.
		2543	I	698	156	0.22	N.D.	N.D.
		2547	I	2,213	396	0.18	H	3/1-10/31
							S	6/1-11/30
							C	8/1-2/28
	Lander (l)	1312	I	26,372	2,820	0.11	C	2/15-6/15; 9/1-12/15
							H	3/1-2/28
		1315	C	1,335	108	0.08	C	5/1-5/15
		1316	C	2,873	170	0.06	C	1/1-2/28
		1322	I	4,664	726	0.16	H	5/1-2/28
							C	10/15-12/31
		1325	I	7,240	272	0.04	S	3/1-5/10
		1332	M	3,247	159	0.05	C,H	6/1-9/30
		1337	C	6,599	125	0.02	C	3/1-2/28
		1353	M	8,694	416	0.05	C,S,H	3/1-2/28
		1355	M	8,941	673	0.08	C,S	4/1-6/5
		1357	M	536	32	0.06	C	6/15-7/14
	Platte River (h,m)	0006	I	1,638	125	0.08	S	12/15-2/27
		0007	I	2,176	229	0.11	S	12/15-2/27
		0008	M	1,200	16	0.01	S	5/1-5/30
		0013	I	9,513	1,478	0.16	S	5/16-10/15
		0018	I	17,955	2,597	0.14	C	All year
		0037	I	36,855	3,734	0.10	S	All year
		0066	I	14,560	1,232	0.11	S	11/1-6/30
					308		C	11/1-6/30
		0130	M	2,246	1,038	0.46	C	All year
		0134	M	4,675	641	0.14	C	All year
		0148	M	24,608	3,193	0.13	C	All year
		0523		9,362	1,270	0.14	S	All year

Table 2-9. Continued.

Project	Resource Area	Allotment Number	Category (a)	Acres (b)	Licensed AUMs (c)	Average AUMs Per Acre	Kind of Livestock (d)	Season of Use
Beaver Creek	Lander (n)	1703	I	98,103	13,238	0.14	C	5/1-11/15
					884		S	6/14-10/31
		1704	M	17,264	1,956	0.11	C	4/3-11/15
							H	4/1-12/15
		1707	I	2,300	183	0.08	C	10/1-12/30
		1715	M	549	14	0.03	H	12/16-4/30
							S	6/29-7/7
		1801	I	78,402	8,321	0.11	S	11/25-4/10; 11/10-12/31
					503		C	5/1-11/30
		1802	I	14,185	1,163	0.08	C	6/1-10/15
		1805	I	6,701	734	0.11	C	5/1-10/15
		1812	I	16,556	516	0.03	C	5/1-10/31
		2001	I	308,087	35,992	0.15	C	5/1-12/31
					11,348		S	3/1-11/30
		2004	I	6,664	651	0.10	C	5/15-4/30
		2011	I	1,874	296	0.16	C	4/1-5/15
		2012	M	5,028	377	0.07	C	4/1-4/30
		2013	I	13,040	1,727	0.13	C	5/1-11/15
		2023	M	654	67	0.10	C	10/1-10/31
Little Buffalo Basin	Grass Creek (i)	0508	I	124,727	7,271	0.06	C	4/16-1/21
							S	11/1-9/15
		0545	I	6,570	982	0.15	C	5/15-12/31
		0564	M	2,466	562	0.23	C	Flexible
		0579	I	15,538	2,316	0.15	C	4/15-6/20; 7/1-12/31
		0594	M	3,375	567	0.17	C	5/8-8/6
		0604	M	56,192	6,600	0.12	C	12/16-3/31
							S	11/14-4/30
		0605	I	66,004	4,878	0.12	C	4/1-6/20; 10/16-2/25
					2,900		S	3/1-7/31; 9/3-11/3
							H	12/1-6/30
		0623	C	8,669	649	0.07	C	4/1-4/30; 11/1-1/31
		2510 (h)	I	2,175	347	0.16	C	N.D.
Salt Creek	Platte River (h,m)	SDW (o)		48,180	5,000	0.10	C,S	30 Days
		0039	I	5,760	384	0.13	S	All year
					376		C	
		0115	M	44,389	566	0.02	S	All year
					282		C	
		0118	M	3,823	262	0.07	C	9/15-11/14
		0153		5,691	999	0.18	S	12/1-4/30
		0154	M	1,400	63	0.08	C	5/1-6/30
					48		S	10/16-11/30

a = M = maintain; no significant problems.
    I = improve; not satisfactory in terms of productivity, condition or management.
    C = custodial; little opportunity for economic improvement.
b = Total federal, state and private acreage in allotment unless noted.
c = Total federal, state and private AUMs unless noted.
d = C = cattle; S = sheep; H = horses.
e = Kemmerer Resource Management Plan, Record of Decision (BLM, 1985c).
f = Grazing allotment management plans, 1983 (BLM, 1982d and BLM, 1983).
g = File data and unpublished draft Resource Management Plan (BLM, 1987a).
h = Acreage and AUMs for public lands only.
i = Source: Grass Creek Grazing DEIS (BLM, 1982b) updated with BLM allotment files.
j = Source: Washakie Resource Management Plan DEIS (BLM, 1986c).
k = Not determined.
l = Source: Lander Grazing Supplement FEIS, Gas Hills Area (BLM, 1986a).
m = Source: Platte River Resource Management Plan DEIS (BLM, 1984a) and file data.
n = Source: Green Mountain Grazing DEIS (BLM, 1982c) and 8LM files.
o = Stock Driveway.

As indicated in Table 2-5, vegetation productivity varies widely throughout the project areas. Plant productivity, range condition and other factors are reflected in the level of grazing allocated for various allotments. Table 2-9 includes licensed forage (AUMs) and the number of acres per AUM. These figures are used in the EIS in conjunction with Soil Conservation Service estimates of potential productivity to evaluate the impact of pipeline and other construction on livestock grazing. While licensed AUMs are paid for and legally available to the rancher, the total allotted forage is often not used (BLM, 1985b; BLM, 1986a). Some ranchers do not stock to fully utilize allocated AUMs because the forage is simply not available. Adjudication of allotments may be decades old or have been based on unrealistic estimates of available forage. Other areas may be in a non-use condition because of market conditions or changes in ranch management.

Impact of land disturbance on forage is calculated based on the average number of AUMs per acre licensed for the allotment. While every acre in an allotment is not of equal value to livestock, the linear nature of pipeline disturbance means that it is likely to disturb both productive and poor grazing land in any given area. The allotment is used as the area of measure because on BLM land, any adjustments to grazing permits due to forage loss would be made on an allotment basis. Since the location of wellfield-related disturbance is not currently known, the amount of forage loss from replacement of producing and injection pipelines is estimated based on a weighted average of the AUMs per acre of all allotments in the wellfield.

Impacts on stocking rates were calculated using the estimated forage lost and the authorized season of use of the allotment (Table 2-9). For a worst case analysis, AUMs were assumed to be lost for the entire season of use. That is, if 30 AUMs were lost in an allotment used for up to 6 months, the stocking loss would be 5 animal units.

2.1.3.2 Crop Production. Cropland includes both irrigated and non-irrigated production of row and forage crops. Table 2-10 is a summary of planted cropland acreage for the project counties. Almost all of the cropland in the study area is on private land. The majority is concentrated in the larger river valleys of the Big Horn Basin, although isolated fields occupy low creek terraces along a few of the small perennial creeks.

Vegetation maps and tables for each project indicate where and how much cropland is crossed by proposed pipelines. There is currently no cropland within any of the field boundaries that could be directly affected by construction activities.

The Soil Conservation Service classifies several soil units in the project area as prime farmland if the required agricultural practices are employed (Soil Conservation Service, 1983a). These units are listed in Table 2-2. Tables for each project also indicate which cropland crossed by pipelines is designated as prime farmland.

Table 2-10. Crop Statistics by Project and County. (a)

Project	County	ACRES PLANTED							
		Wheat	Barley	Oats	Dry Beans	Sugar Beets	Corn	Hay	Total
Fontenelle	Lincoln	700	20,700	1,700	0	0	0	76,500	99,600
	Sweetwater	0	500	1,600	0	0	0	16,500	18,600
Elk Basin	Park	1,100	35,800	5,100	6,100	12,000	1,400	35,500	97,000
	Big Horn	1,600	26,600	7,500	4,200	13,700	6,800	30,500	90,900
	Washakie	200	16,400	1,900	300	10,250	2,300	12,500	43,850
	Hot Springs	100	1,500	1,500	0	250	100	18,000	21,450
	Fremont	1,000	24,400	9,100	2,400	100	900	82,000	119,900
	Natrona	1,500	100	3,300	0	0	200	22,500	27,600
Beaver Creek	Fremont	1,000	24,400	9,100	2,400	100	900	82,000	119,900
Little Buffalo Basin	Park	1,100	35,800	5,100	6,100	12,000	1,400	35,500	97,000
	Hot Springs	100	1,500	1,500	0	250	100	18,000	21,450
	Washakie	200	16,400	1,900	300	10,250	2,300	12,500	43,850
Salt Creek	Natrona	1,500	100	3,300	0	0	200	22,500	27,600

a = Source: Wyoming Agricultural Statistics, 1986.

2.2 FONTENELLE CO_2 SUPPLY PROJECT

2.2.1 Soils

There are several general types of soils in the Raptor field, in areas which would be traversed by the gas gathering system and in the Fontenelle Plant area, including:

Map Symbol	General Soil Unit
Sweetwater County:	
T1	Typic Calciorthids, frigid: Very deep, well drained, nearly level or gently sloping soils on stream terraces and alluvial fans;
U1	Typic Calciorthids, frigid - Typic Torriorthents, shallow: Moderately deep to very shallow, well drained, undulating to moderately steep soils of upland plains underlain with sandstone and shale; and
U3	Typic Torripsamments, frigid - Typic Natrargids, frigid - Typic Torriorthents, frigid, shallow: Very deep, excessively-drained soils in sand hills and moderately deep and very shallow, well drained, very strongly alkaline, undulating to rolling soils on plains;
Lincoln County:	
T1	Typic Calciorthids, frigid - Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Rock outcrop: Nearly level and gently sloping, well drained and excessively drained, shallow and deep gravelly sandy loam soils;
U1	Typic Torriorthents, frigid - Typic Torrifluvents, frigid - Typic Calciorthids, frigid - Rock outcrop: Undulating to moderately steep, excessively drained and well drained, shallow and deep sandy and loamy soils formed in shale and sandstone bedrocks;
U3	Typic Torriorthents, frigid - Typic Calciorthids, frigid - Typic Torripsamments, frigid - Rock outcrop: Undulating to very steep, well drained and excessively drained, deep, moderately deep, and shallow sand dune soils and sandy and loamy soils formed in shales and sandstones of the Green River and Bridger Formations; and
V1	Ustic Torrifluvents, frigid - Fluvaquentic Halaquepts, frigid - Typic Cryaquolls, frigid - Typic Cryaquents, frigid - Riverwash: Nearly level, poorly drained to moderately well drained, shallow to deep sandy and loamy alluvial soils on floodplains and bottomlands of the Green River and its tributaries.

Table 2-11 lists the soil units mapped in the Fontenelle CO_2 Supply Project vicinity. This table includes the potential productivity and potential vegetation type of the soils. Table 2-12 lists the soil series in the area and gives their taxonomic classification. Appendices B, C and D contain tables of engineering properties, physical and chemical properties and soil and water features of the project area soils.

Table 2-11. **Fontenelle CO2 Supply Project Soil Units, Including Potential Production and Vegetation Type. (a)**

Map Symbol	Soil Name	Potential Production (Pounds Per Acre) (b) Range	Normal	Potential Vegetation (c)
LINCOLN COUNTY				
L300	Chrisman-Dines-Laney complex, 0-3% (d)	300-600	450	DS
	35% Chrisman			
	35% Dines			
	20% Laney			
L301	Monte-Leckman complex, 1-6%			
	60% Monte	300-600	450	DS
	30% Leckman	300-700	450	S/G
L302	Sagecreek-Monte complex, 1-6%			
	60% Sagecreek	300-700	500	DS
	30% Monte	300-700	500	DS
L303	Chrisman silty clay loam, 0-1%			
	95% Chrisman	300-600	450	DS
L304	Langspring-Cambarge complex, 0-5%			
	65% Langspring	300-700	500	S/G
	25% Cambarge	300-700	500	S/G
L305	Kandaly loamy fine sand, 2-20%			
	95% Kandaly	350-700	500	S/G
L306	Boltus-Horsley-Kandaly association, 1-20%			
	30% Boltus	300-600	450	DS
	30% Horsley	150-300	200	DS
	25% Kandaly	350-700	500	S/G
L307	Chrisman-Boltus association, 0-5%			
	65% Chrisman	300-600	450	DS
	25% Boltus	300-600	450	DS
L308	Langspring-Langspring Variant-Garita complex, 2-5%			
	35% Langspring	300-700	500	S/G
	35% Langspring Variant	300-700	500	S/G
	15% Garita	300-700	500	S/G
L308A	Langspring Variant-Langspring-Garita Variant, 1-5%			
	45% Langspring Variant	300-700	500	S/G
	20% Langspring	300-700	500	S/G
	20% Garita Variant	300-700	500	S/G
L309	Langspring Variant-Langspring complex, 0-3%			
	60% Langspring Variant	300-700	500	S/G
	30% Langspring	300-700	500	S/G
L310	Langspring Variant-Langspring-Boltus complex, 3-12%			
	45% Langspring Variant	300-700	500	S/G
	25% Langspring	300-700	500	S/G
	15% Boltus	300-600	450	DS
L311	Sagecreek-Haterton-Garsid association, 2-15%			
	35% Sagecreek	300-700	500	DS
	25% Haterton	200-450	350	S/G
	20% Garsid	300-700	500	S/G
L312	Haterton-Horsley-Garsid complex, 2-30%			
	35% Haterton	200-450	350	S/G
	30% Horsley	150-300	200	DS
	20% Garsid	300-700	500	S/G
L313	Dunul Variant-Garsid-Boltus complex, 8-30%			
	40% Dunul Variant	200-450	350	DS
	25% Garsid	300-700	500	S/G
	20% Boltus	300-600	450	S/G, DS

Table 2-11. Continued.

Map Symbol	Soil Name	Potential Production (Pounds Per Acre) (b) Range	Normal	Potential Vegetation (c)
L314	Haterton-Tasselman-Garita Variant complex, 1-5%			
	30% Haterton	200-450	350	S/G
	25% Tasselman	200-450	350	S/G
	25% Garita Variant	200-450	350	S/G
L315	Haterton-Boltus-Tasselman complex, 1-8%			
	35% Haterton	200-450	350	S/G
	35% Boltus	300-600	450	DS
	15% Tasselman	200-450	350	S/G
L316	Langspring-Tresano-Forelle Variant complex, 1-6%			
	40% Langspring	300-700	500	S/G, DS
	30% Tresano	300-700	500	S/G, DS
	20% Forelle Variant	300-700	500	S/G, DS
L317	Tresano-Langspring Complex, 0-4%			
	60% Tresano	300-700	500	S/G, DS
	20% Langspring	300-700	500	S/G, DS
L318	Tresano-Garsid-Forelle association, 0-6%			
	35% Tresano	300-700	500	S/G, DS
	30% Garsid	200-450	350	S/G, DS
	15% Forelle	300-700	500	S/G, DS
L400	Sandbranch-Chrisman-Laney complex, 0-5%			
	40% Sandbranch	300-600	450	DS
	25% Chrisman			
	20% Laney			
L402	Fluvents, 0-4%			R
L410	Haterton-Garsid-Hermering Variant complex, 8-35%			
	30% Haterton	200-450	350	G, S/G
	25% Garsid	200-450	350	G, S/G
	25% Hermering	200-450	350	G, S/G
L411	Horsley-Huguston-Rock Outcrop complex, 15-60%			
	30% Horsley	150-300	200	DS
	25% Huguston	150-300	200	DS
	20% Rock Outcrop	150-300	200	DS
L412	Pepal-Cambarge-Dunkle association, 0-8%			
	50% Pepal	300-700	500	S/G
	30% Cambarge	300-700	500	S/G
L413	Leckman fine sandy loam, 0-5%	300-700	500	S/G
L414	Cambarge-Dunkle-Dunul Variant complex, 2-10%			
	40% Cambarge	300-700	500	S/G
	25% Dunkle	300-700	500	S/G
	20% Dunul Variant	200-450	350	S/G
SWEETWATER COUNTY				
S110	Wet Alluvial Soils			
S116	Gravelly Terrace Soils			
S121	Canyons and Terrace Scarps			
S123	Residual Uplands, moderately deep soils			
S124	Residual Uplands, shallow soils			
S126	Residual Upland Soils and Alkaline-Saline Soils			

a = Source: Data From Miscellaneous BLM Surveys in Lincoln and Sweetwater Counties.
Sweetwater County data are limited to general soil associations listed in the Sandy Grazing EIS.
b = Range = Unfavorable years to favorable years; Normal = median years.
c = Based on soil unit description and/or range site designation and description.
S/G = Sagebrush/Grassland, DS = Desert Shrub; G = Grassland;
C = Cropland; R = Riparian; GW = Greasewood subtype of Riparian
d = % = Percent slope.

Table 2-12. Taxonomic Classification of Fontenelle CO_2 Supply Project Soils. (a)

Series	Taxonomic Classification
Boltus	Clayey, montmorillonitic (calcareous), frigid, shallow Typic Torriorthents
Cambarge	Loamy-skeletal, mixed, frigid Typic Calciorthids
Chrisman	Fine, montmorillonitic (Calcareous), frigid Typic Torrifluvents
Dines	Fine-silty, mixed (calcareous), frigid Typic Torrifluvents
Dunkle	Coarse-loamy, mixed, frigid Typic Camborthids
Dunul Variant	Sandy-skeletal, mixed, frigid, shallow Typic Torriorthents
Forelle	Fine-loamy, mixed Borollic Haplargid
Forelle Variant	Fine-loamy, mixed Borollic Haplargid
Garita	Loamy-skeletal, mixed, frigid Typic Calciorthids
Garita Variant	Loamy-skeletal, mixed, frigid Typic Calciorthids
Garsid	Fine-loamy, mixed (calcareous), frigid Typic Torriorthents
Haterton	Loamy, mixed (calcareous), frigid Typic Torriorthents
Hemering Variant	Loamy-skeletal, mixed (calcareous), frigid Typic Torriorthents
Horsely	Loamy, mixed (calcareous), frigid, shallow Typic Torriorthents
Huguston	Loamy, mixed (calcareous), frigid, shallow Typic Torriorthents
Kandaly	Mixed, frigid Typic Torripsamments
Laney	Fine-loamy, mixed (calcareous), frigid Typic Torrifluvents
Langspring	Fine-loamy, mixed, frigid Typic Calciorthids
Langspring Variant	Fine-loamy, mixed, frigid Typic Calciorthids
Leckman	Coarse-loamy, mixed (calcareous), frigid Typic Torriorthents
Monte	Fine-loamy, mixed (calcareous), frigid Typic Torriorthents
Pepal	Coarse-loamy, mixed, frigid Typic Calciorthids
Sagecreek	Fine-loamy, mixed, frigid Typic Camborthids
Sandbranch	Fine-loamy, mixed, frigid Typic Natrangids
Tasselman	Loamy, mixed (calcareous), frigid, shallow Lithic Torriorthents
Tresano	Fine-loamy, frigid Typic Haplargids

a = Source: Soil Conservation Service Series descriptions (Form 5).

Available Order 3 soil survey data for the Fontenelle CO_2 Supply Project are mapped on Soil Maps F-1 through F-3. Preliminary Order 3 survey data are available for about 15 miles of the 26-mile gas gathering system in Lincoln County. Sweetwater County soil data are from a more general survey (BLM, 1978). Soils of the gas processing plant site are extrapolated from adjacent surveyed soils and aerial photographs. Of the 15 miles of surveyed route, less than 1 mile has shallow soils and 3.2 miles have shallow soils with low permeability. Virtually all of the plant site and its access road have fine-textured soils with permeability and salinity problems.

Most of the terrain crossed by the pipeline and within the Raptor Field is gently rolling. While small areas of steep slopes will be crossed (e.g., small hills or minor incised ephemeral drainages), only one area of steep slopes, near Slate Creek, has been identified (Appendix A, Table A-9).

2.2.2 Vegetation

Vegetation is fairly uniform within the study area but varies with soils and topography. The Fontenelle CO_2 Supply Project area lies within the Green River and Great Divide Basin 7- to 9-inch precipitation zone (Soil Conservation Service, 1970). There are seven vegetation types mapped in the Fontenelle CO_2 Supply Project vicinity. They are: Sagebrush/Grassland, Desert Shrub, Grassland, Mixed Shrub, Riparian, Cropland and Disturbed. Construction of the Fontenelle Plant, gas gathering system and wellfield activities will affect four of them: Sagebrush/Grassland, Desert Shrub, Grassland and Riparian areas including the Greasewood subtype (Vegetation Maps F-1 through F-3). Table 2-13 indicates by milepost the vegetation types which would be disturbed by pipeline and plant construction. The plant site, roads, well pads and gas gathering system will disturb about 836 acres. Sagebrush/Grassland is the dominant type in the area representing about 735 acres or almost 90 percent of the disturbance.

Disturbance from the CO_2 well pads, field access roads and field gathering system is included in the Sagebrush/Grassland vegetation type even though the precise number and location of wells has not been determined. Designation of this disturbance as Sagebrush/Grassland is reasonable because most of the Raptor Field is mapped as Sagebrush/Grassland. Since wells would not be permitted within 500 feet of Fontenelle Reservoir, no Riparian vegetation adjacent to the reservoir would be disturbed.

The majority of Riparian vegetation along the gas gathering system route is associated with ephemeral drainages. In the vicinity of the plant site, most of this is the Greasewood subtype with small ephemeral creeks with shrub/herb communities meandering in the bottoms. A more diverse Riparian community would be traversed at the Green River crossing. This community includes Cottonwood, willows, Buffalo berry, roses, Greasewood, arrowgrass, Alkali sacaton, and Nebraska sedge (Bureau of Reclamation, 1977). About 0.2 acre of the disturbance would be associated with block valves to be used for the life of the gas gathering system.

Two plants of special interest are known from the general vicinity of the Fontenelle CO_2 Supply Project. They are: Payson's beardtongue (Penstemon paysoniorum) and the Starvling milkvetch (Astragalus jejunus ssp. nov).

Table 2-13. Vegetation Disturbed During Construction of the Fontenelle CO2 Supply Project. (a)

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
Gas Processing Plant		40.0	Riparian	Estimated to disturb about 26 acres of Greasewood and 14 acres of Grassland
			Grassland	
Plant Access Road	2.0	12.1	Grassland	
	0.9	5.5	Riparian	Ephemeral tributary to Shute Creek: meandering herbaceous community surrounded by greasewood
	0.1	0.6	Desert Shrub	
0 - 1.4	1.4	12.7	Sagebrush/Grassland	
1.4 - 1.5	0.1	0.9	Grassland	
1.5 - 1.6	0.1	0.9	Sagebrush/Grassland	
1.6 - 1.8	0.2	1.8	Grassland	
1.8 - 2.2	0.4	3.6	Sagebrush/Grassland	
2.2 - 2.5	0.3	2.7	Riparian	Greasewood flat surrounding herbaceous riparian vegetation
2.5 - 2.7	0.2	1.8	Riparian	Ephemeral tributary to Shute Creek: meandering herbaceous community surrounded by greasewood
2.7 - 2.9	0.2	1.8	Sagebrush/Grassland	
2.9 - 3.0	0.1	0.9	Riparian	Ephemeral tributary to Shute Creek: meandering herbaceous community surrounded by greasewood
3.0 - 3.8	0.8	7.3	Grassland	
3.8 - 4.1	0.3	2.7	Sagebrush/Grassland	
4.1 - 4.6	0.5	4.6	Desert Shrub	
4.6 - 4.8	0.2	1.8	Sagebrush/Grassland	
4.8 - 5.2	0.4	3.6	Desert Shrub	
5.2 - 5.4	0.2	1.8	Sagebrush/Grassland	
5.4 - 5.5	0.1	0.9	Desert Shrub	
5.5 - 9.2	3.5	31.8	Sagebrush/Grassland	
6.5 - 6.6 (b)	0.1	0.9	Riparian	Ephemeral drainage with increased shrub density
6.7 - 6.8	0.1	0.9	Riparian	Ephemeral drainage with increased shrub density
Road crossing bore pits		1.1	Sagebrush/Grassland	
9.2 - 9.6	0.4	3.6	Grassland	
9.6 - 9.8	0.2	1.8	Riparian	Green River: East and west sides are herbaceous and shrub community with greasewood, rabbitbrush, arrowgrass, Alkali sacaton and Nebraska sedge; West side includes area of trees and shrubs including Cottonwood, willow, buffalo berry and roses.
Block valves		0.2	Riparian	
River Crossing Staging Area		2.3	Riparian	
9.8 - 16.8	7.0	63.7	Sagebrush/Grassland	
West Gathering Line (c)				
0w - 2.7w	2.5	22.8	Sagebrush/Grassland	
.9w - 1.0w	0.1	0.9	Riparian	Ephemeral drainage with higher density shrubs
2.0w - 2.1w	0.1	0.9	Riparian	Ephemeral drainage with higher density shrubs
Road crossing bore pits		1.1	Sagebrush/Grassland	
2.7w - 3.0w	0.3	2.7	Riparian	Slate Creek: Incised drainage with dense shrubs
3.0w - 3.3w	0.3	2.7	Desert Shrub	
3.3w - 7.2w	3.8	34.6	Sagebrush/Grassland	
6.3w - 6.4w	0.1	0.9	Riparian	Ephemeral drainage with higher density shrubs

Table 2-13. Continued.

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
Field Access Roads (d)	30.0	181.8	Sagebrush/Grassland	
Well Pads (d)		100.0	Sagebrush/Grassland	
Gas Gathering Pipes (d)	30.0	273.0	Sagebrush/Grassland	
Project Totals	19.6	735.4	Sagebrush/Grassland (e)	
	1.5	39.8	Grassland (f)	
	1.3	12.4	Desert Shrub (g)	
	1.6	48.5	Riparian (h)	
Total Disturbance		836.2		

a = Mileage derived from Vegetation Maps R-1 through R-3; pipeline disturbance width is 75 feet unless otherwise noted. Minimum mileage length recorded is 0.1 miles, therefore the width of narrow ephemeral drainages has been exaggerated.
b = Indented mileages indicate riparian areas, usually ephemeral drainages, within the range of another vegetation type.
c = West gathering system pipeline begins at approximately milepost 7.2 of the main pipeline.
d = Location of wells and their associated roads and pipelines is not currently known; most vegetation disturbed in the field will be Sagebrush/Grassland; Assumes 3 miles of 50-foot wide access road per well and 3 miles of 75-foot pipeline per well.
e = Acreage includes road crossing pits.
f = Acreage includes gas processing plant and plant access road which is 50 feet wide.
g = Acreage includes plant access road, which is 50 feet wide.
h = Acreage includes gas processing plant, plant access road (50 feet wide), block valves and river crossing staging area.

Payson Beardtongue. Penstemon paysoniorum is a federal category 3C and Heritage Program G3S3 species. This perennial herb, of the figwort family (Scrophulariaceae), is usually found on calcareous, clay slopes and ridges, often barren of most other vegetation (Exxon, 1985). The known population closest to any portion of the Fontenelle CO_2 Supply Project is about ten miles southwest of the proposed Fontenelle Gas Processing Plant.

Starvling Milkvetch. Astragalus jejunus ssp nov. is a federal category 2 plant designated on the U.S. Fish and Wildlife Service review list as a new subspecies. The species is known from Rich County, Utah, east-central Nevada, Idaho and southwestern Wyoming. It is not clear which of the known Wyoming populations includes the candidate subspecies (Thorne, 1987; Schultz, 1987; Rocky Mountain Heritage Task Force, 1987) so the entire species is discussed below. The Starvling milkvetch is a very short (up to 2 inches tall) perennial herb of the pea family (Fabaceae). Quarter inch, long pink-purple flowers bloom throughout most of the summer. Pods are bladdery-inflated and mottled.

The species grows on red clay hills in either sagebrush (Sagebrush/Grassland) or sagebrush-juniper (Coniferous Woodland) communities on red clay hills. It is often found on windswept ridges (Welsh et al., 1987). The closest known population is in Lincoln County about 15 miles west of the proposed Fontenelle Gas Processing Plant.

2.2.3 Agriculture

Agriculture in the Fontenelle CO_2 Supply Project area is primarily livestock production. The project area is divided into five large allotments, three in the Kemmerer Resource Area and two in the Green River Resource Area (see Table 2-9). Adjudication of the areas was based on a reconnaissance range survey conducted in 1963 - 1965. Licensed use in allotments in the Fontenelle Project area ranges from an average of 0.04 AUM per acre (about 25 acres per AUM) to 0.12 AUM per acre (about 8 acres per AUM). East of the Green River, AUM's are allocated primarily to sheep. West of the river, use has been about equally distributed between sheep and cattle (BLM, 1982d; BLM, 1983; BLM, 1985b).

There is limited crop cultivation in the Fontenelle CO_2 Supply Project area. Land usually flooded by Fontenelle Reservoir is currently being farmed since the water level has been drawn down for dam repair. There is some hay production at Exxon's Shute Creek Plant site.

2.3 ELK BASIN CO_2 PROJECT

2.3.1 Soils

There are several general types of soils in the Elk Basin CO_2 Project study area, including:

Map Symbol	General Soil Unit
	Carbon County, Montana:
5	Midway - Travessilla: Strongly sloping to steep, shallow, well-drained silt loams and silty clay loams of shale and sandstone uplands; and

7 Harvey - Stormitt: Nearly level to steep, deep, well-drained loams of intermediate terraces and fans.

Park County:

T3 Ustollic Haplargids - Ustic Torriorthents, mesic, shallow: Very deep and shallow, well and somewhat excessively-drained gravelly fine sandy loam, sandy loam, and clay loam soils on nearly level to very steep terraces and terrace escarpments. Soils are forming in alluvium;

T5 Typic Haploargids, mesic: Very deep, well and somewhat excessively-drained clay loam, loam and gravelly fine sandy loam soils on nearly level to very steep terraces and terrace escarpments. Soils are forming in alluvium;

U1 Typic Torriorthents, mesic - Rock outcrop: Shallow and moderately deep, well-drained clay loam soils and rock outcrop on gently sloping to very steep bedrock controlled uplands. Soils are forming in residuum. Bedrock is shale; and

U2 Typic Torriorthents, mesic - Rock outcrop: Moderately deep and shallow, well-drained sandy loam soils and rock outcrops on gently sloping to very steep bedrock controlled uplands. Soils are forming in residuum. Bedrock is sandstone.

Big Horn County:

A1 Typic Fluvaquents, mesic - Typic Torriorthents, mesic - Typic Torrifluvents, mesic: Very deep, somewhat poorly- to excessively-drained loamy sand, very cobbly sand and loam soils on nearly level to sloping floodplains, low stream terraces, and alluvial fans. Soils are forming in mixed alluvium;

A3 Typic Torrifluvents, mesic - Typic Natrargids, mesic: Very deep and moderately deep, well-drained clay loam, sandy clay loam, and sandy loam soils on nearly level to sloping alluvial fans and floodplains. Soils are forming in alluvium;

T1 Typic Haplargids, mesic: Very deep, well and somewhat excessively-drained sandy loam, loam and gravelly fine sandy loam soils on nearly level to very steep alluvial fans, terraces, and terrace escarpments. Soils are forming in gravelly alluvium; and

U1 Typic Torriorthents, mesic - Rock outcrop: Shallow and moderately deep, well-drained clay loam soils and rock outcrops on gently sloping to very steep bedrock controlled uplands. Soils are forming in residuum. Bedrock is shale.

Washakie County:

1 Typic Torrifluvents, mesic: Deep, well drained, nearly level to moderately sloping soils on alluvial fans, terraces, and floodplains and in valleys;

3 Typic Torriorthents, mesic - Rock outcrop - Typic Torrifluvents, mesic: Shallow and deep, well drained, gently sloping to steep soils, and rock outcrops on hills, ridges, escarpments, fans and terraces;

5 Typic Haplargids, mesic - Typic Natrargids, mesic: Deep and shallow, well drained, gently sloping to steep soils on alluvial fans and uplands; and

6 Ustic Torriorthents, mesic - Ustollic Haplargids, mesic: Deep and shallow, well drained, gently sloping to steep soils on alluvial fans and uplands.

Hot Springs County;

F1 Ustic Torriorthents, frigid - Rock outcrop: Very deep and shallow, well drained, reddish loamy soils formed in alluvium and material weathered from sandstone. Bedrock is sandstone and shale;

M7 Rock outcrop - Argic Cryoborolls - Lithic Cryoborolls: Moderately deep and very shallow, well drained, brownish, channery and loamy soils formed in material weathered from limestone and sandstone; and

U6 Ustic Torriorthents, mesic - Rock outcrop: Very deep and shallow, well drained, brownish loamy soils formed in alluvium and material weathered from interbedded sandstone and shale.

Fremont County:

MF3 Haploborolls - Argiborolls - Rock outcrops: Dominately dark-colored soils of the mountains and mountain valleys that are usually moist in some parts during the summer. Soils are formed from residual materials;

MF4 Haploborolls, shallow: Dominately dark-colored soils of the mountains and mountain valleys that are usually moist in some parts during the summer. Soils are formed from residual materials; and

BM10 Haplargids - Torriorthents: Dominately light-colored soils of basins, terraces and fans which are usually dry in all parts. Soils are formed from residual materials.

Natrona County:

6 Ustic Torriorthents, mesic - Borollic Lithic, mixed - Rock Outcrop: Shallow, well drained, sloping to very steep soils and rock outcrop on dip slopes, escarpments and deeply entrenched uplands. Soils are moderately coarse to moderately fine textured with few to many rock fragments formed in interbedded or mixed parent materials.

7 Ustollic Haplargids, mesic - Ustollic Natrargids, mesic -Ustic Torriorthents, mesic: Moderately deep to deep, well-drained soils on undulating to rolling terraces, fans, foot slopes and hillslopes. The soils are fine to moderately coarse textured formed in alluvium or mixed sources.

9 Typic Haplargid, mesic - Typic Haplargids, mesic - Typic Torriorthents, mesic: Shallow to deep, well-drained soils on undulating to hilly terraces, fans, hillslopes and ridges. The soils are moderately coarse to fine textured with few to many rock fragments formed in alluvium and residuum from mixed sources.

12 Ustic Torripsamments, mesic - Ustollic Haplargids, mesic - Ustollic Haplargids, mesic: Deep, excessively to well drained, sloping to moderately steep, medium- to coarse-textured soils on eolian sand deposits.

Table 2-14 lists the soil units mapped in the Elk Basin CO_2 Project vicinity. This table includes the potential productivity and potential vegetation type of the soils. Table 2-15 lists the soil series in the area and gives their taxonomic classification. Appendices B, C and D contain tables of engineering properties, physical and chemical properties and soil and water features of the project area soils.

Most of the soils which would be disturbed during pipeline construction have at least some limiting feature (Appendix A, Table A-1, 2, 3, 4, 6, 7 and 8 and Soil Maps EB-1 through EB-40). Of the over 178 miles of pipeline, only 31.0 miles have no soils-based limitations. About 25 miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. About 11 additional miles are limited by more coarse soils, i.e., sandy or coarser soil and/or more than 35 percent fragments. The remaining soils have depth and/or permeability problems. About 24 miles have only low permeability and 26 miles are shallow. About 56 miles are both shallow and have low permeability and 5 miles have salinity problems. Soils in any of these categories may have an additional limitation of a high water table. Most riparian areas and many croplands, including prime farmland soils, are included in the latter category. Areas of steep slopes are listed in Appendix A, Table A-9.

2.3.2 Vegetation

Vegetation varies in the study area with soils, precipitation, topography and land management practices. The Elk Basin CO_2 Project area lies within the Big Horn Basin 5- to 9-inch, Foothills and Mountains East 15- to 19-inch, Foothills and Basins East 10- to 14-inch, Wind River Basin 5- to 9-inch and High Plains Southeast 10- to 14-inch precipitation zones (Soil Conservation Service, 1970). There are nine vegetation or land cover types mapped for the vicinity of the Elk Basin CO_2 Trunk Pipeline, the Recycle Plant site and within the Elk Basin Unit boundaries. They are: Sagebrush/Grassland, Desert Shrub, Grassland, Mixed Shrub, Coniferous Woodland, Riparian, Cropland, Barren/Badlands and Disturbed areas (Vegetation Maps EB-1 through EB-40). Affinis (1986b) provides detailed site-specific descriptions of vegetation types of the Elk Basin Field. These descriptions were prepared from a field survey of the area. Table 2-16 indicates by milepost the vegetation types which would be disturbed by pipeline and plant construction. The 178-mile-long trunk pipeline and recycle plant will disturb about 1,678 acres. Sagebrush/Grassland and Desert Shrub are the dominant types in the area, accounting for over 75 percent of the disturbed vegetation. Only the Coniferous Woodland type would be unaffected by construction.

The major riparian areas are in the Shoshone, Greybull and Big Horn River valleys. The proposed pipeline route is in an existing pipeline corridor at all three river crossings. Riparian vegetation disturbed by previous construction has been restored successfully along each river.

Table 2-14. Elk Basin CO2 Project Soils, Including Potential Production and Vegetation Types. (a)

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
Carbon County, Montana				
Bc	Bowbac loam, 4-8% (d)	600-800 (e)		G
Bd	Bowbac loam, 8-15%	600-800		G
Bm	Bowbac-Travessilla complex, 4-8%			
	Bowbac	600-800		G
	Travessilla	700-1,000		G
Cg	Colby silt loam, 4-8%	600-800		G
Hh	Harvey loam, 8-15%	700-1,000		
Hn	Haverson-Heldt silty clay loams, 0-4%			
	Haverson	900-1,500		G, S/G
	Heldt	900-1,500		G, S/G
Hs	Heldt silty clay loams, 0-2%	900-1,500		G, S/G
Hu	Heldt silty clay loam, 4-8%	900-1,500		G, S/G
Hw	Heldt silty clay loam, saline, 0-6%			
Kd	Kyle clay, 4-8%	900-1,500		G, S/G
LO	Lismas clay, hilly	300-700		G, S/G
MR	Midway-Travessilla association, hilly			
	Midway	700-1,000		G
	Travessilla	700-1,000		G
MT	Midway-Travessilla association, steep			
	Midway	700-1,000		G
	Travessilla	700-1,000		G
RM	Rock outcrop-Travessilla complex, steep			
	Rock outcrop			
	Travessilla	500-800		S/G, CW
SC	Shale outcrop			
Tv	Tonra gravelly silty clay loam, 2-4%			
TW	Torchlight clay, sloping	300-600		DS
TY	Travessilla silt loam, sloping	700-1,000		G
Park County, Eastern part				
Pa 1	Fluvaquents, Str saline			
P2AB	(f)			
P3AB	(f)			
P5AB	Las Animas sandy loam 0-6%	1,800-2,600	2,400	R, G, C
P5u	Fluvaquents 0-6%	3,000-6,000	4,500	R
Pa9A	(f)			
P11A	Garland loam 0-3%	225-600	400	S/G,
P13AB	Willwood very cobbly loamy sand, 0-6%	1,400-2,400	1,800	R
P15A	Emblem loam 0-3%	225-600	400	G, S/G
P15C	Emblem-Griffy complex 0-10%	225-600	400	S/G
	50% Emblem loam			
	30% Griffy loam			
P15jAB	(g)			
P16AB	Silvertip-Copeman complex 0-6%			
	70% Silvertip	225-600	400	G, S/G
	20% Copeman	225-600	400	G, S/G
P16AC	Silvertip-Copeman complex 0-10%	225-600	400	G, S/G
P18B	Spomer fine sandy loam, 3-6%	225-600	400	G, S/G
P22AC	(f)			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
P24A	Aldrich clay loam, 0-3%	200-550	300	DS
P26AC	(f)			
P37AD	Kishona loam 0-15%	225-600	400	G, S/G
P41A	Stutzman silty clay loam 0-3%	200-550	300	DS
P41jAB	(g)			
P42A	Apron sandy loam 0-3%	225-600	375	G, S/G,
P42AC	Apron sandy loam 0-10%	225-600	375	G, S/G
P42AD	(g)			
P42B	Apron sandy loam 3-6%	225-600	375	G, S/G,
P43A	Youngston clay loam 0-3%	200-550	300	DS
P43CA	Youngston clay loam 0-10%	200-550	300	DS
P43CB	(g)			
P45AB	Youngston and Lostwells soils, wet 0-6%	1,800-2,600	2,400	R,
	40% Youngston clay loam, wet			
	40% Lostwells sandy clay loam, wet			
P47AB	Torchlight silty clay loam 0-6%	200-550	350	DS
P48A	Youngston clay loam, moderately wet 0-3%	1,400-2,400	1,800	R,
Pa51AC	(f)			
P61AB	Vanda silty clay 0-6%	500-1,300	1,000	G, DS
P63AB	Binton clay loam 0-6%	200-550	350	DS
P68A	Lostwells sandy clay loam 0-3%	225-600	400	G, S/G
P68AC	(g)			
P68AD	Lostwells sandy clay loam 0-10%	225-600	400	G, S/G
P70AB	Uffens sandy loam 0-6%	200-550	350	DS
Pa70AB	(g)			
P71A	Greybull clay loam 0-3%	200-550	350	DS
P72A	Worland sandy loam 0-3%	160-375	300	G, S/G
P72jAB	(g)			
P72B	Worland sandy loam 3-6%	160-375	300	G, S/G
P72C	(g)			
P73B	Deaver loam 3-6%	200-550	350	DS
P74A	(f)			
P90BC	(f)			
P93A	Olney sandy loam 0-6%	160-375	300	G, S/G
P93C	Olney sandy loam 6-10%	160-375	300	G, S/G
P96AC	(f)			
P98	Bowbac fine sandy loam 2-15%	225-600	400	G, S/G
P99A	(f)			
P101	Aquepts, nearly level 0-3%			
P102	Badland 0-100%			
P103	Rock Outcrop 0-100%			
P108	Torrifluvents-Torriorthents, gullied 0-100%			
	45% Torrifluvents			
	35% Torriorthents			
P111	Rock Outcrop-Shingle-Tassel complex, 3-100%			S/G
	30% Rock Outcrop			
	25% Shingle clay loam	160-375	300	G, S/G
	25% Tassel fine sandy loam	200-400	325	G, S/G
P248	Fluvents-Fluvaquents complex, 0-5%			
	40% Fluvents	1,400-2,400	1,800	R, C
	40% Fluvaquents	3,000-6,000	4,500	R
P294	Hiland-Forkwood Variant association 0-3%			
	55% Hiland fine sandy loam	225-600	400	S/G
	35% Forkwood Variant loam	225-600	400	S/G

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
P303A	Willwood-Shoshone-Willwood Variant complex 0-3%	1,400-2,400	1,800	R,
	40% Willwood very cobbly loamy sand			
	20% Shoshone loam			
	20% Willwood Variant sandy loam			
P313A	Sharland-Preatorson complex 0-3%			
	45% Sharland clay loam	225-600	400	G, S/G
	35% Preatorson gravelly fine sandy loam	150-350	250	G, S/G
P315BE	Willwood-Preatorson-Rock Outcrop complex, 3-100%			
	40% Willwood very cobbly loamy sand	1,400-2,400	1,800	R
	30% Preatorson gravelly fine sandy loam	100-300	200	S/G
	15% Rock Outcrop			
P337	Kishona-Otero complex 0-30%			S/G, DS
	40% Kishona loam	500-1,100	800	S/G, OS
	40% Otero sandy loam	500-1,100	800	S/G, OS
P340	Winnett-Arvada-Ulm loams 0-10%			OS
	30% Winnett loam	100-300	200	
	25% Arvada loam	100-300	200	OS
	25% Ulm loam	225-600	375	G, S/G
P350	Shingle-Thedalund-Midway complex 0-30%			
	35% Shingle clay loam	160-375	300	G, S/G
	30% Thedalund clay loam	225-600	400	G, S/G
	30% Midway silty clay loam	160-375	300	DS
P351AC	Zigweid-Thedalund-Shingle association 0-40%			
	30% Zigweid silt loam	225-600	400	S/G
	25% Thedalund loam	225-600	400	S/G
	25% Shingle laom	160-375	300	G, S/G
P358	Gaynor-Midway-Stutzman silty clay loams 0-30%			
	35% Gaynor silty clay loam	250-500	350	DS
	25% Midway silty clay loam	85-300	175	OS
	20% Stutzman silty clay loam	225-600	375	G, S/G
P363AD	(f)			
P371jA	(g)			
P371AD	Persayo-Greybull clay loams 0-30%	250-550	350	OS
	60% Persayo clay loam	250-550	350	OS
	30% Greybull clay loam	250-550	350	DS
P372AO	Worland-Oceanet sandy loams 0-30%			
	45% Worland sandy loam	225-600	400	S/G
	35% Oceanet sandy loam	200-400	325	G, S/G
P372CD	Worland-Persayo-Oceanet complex 2-45%			
	40% Worland sandy loam	225-600	400	S/G
	20% Persayo clay loam	200-550	350	OS
	20% Oceanet sandy loam	200-400	325	G, S/G
P373BE	Deaver-Chipeta-Stutzman complex 0-30%	200-550	350	DS
	40% Oeaver			
	30% Chipeta			
	20% Stutzman			
P374BE	Chipeta-Persayo-Rock Outcrop complex 3-90%	200-550	350	DS
	35% Chipeta clay loam			
	25% Persayo clay loam			
	25% Rock Outcrop			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
P377	Midway-Shingle-Rock Outcrop complex, 0-90%			
	45% Midway silty clay loam	160-375	300	DS
	25% Shingle clay loam	160-375	300	G, S/G
	20% Rock outcrop			
P382	Worland Variant-Tassel complex 2-30%			
	50% Worland Variant sandy loam	500-1,100	700	S/G
	70% Tassel fine sandy loam	200-400	325	G, S/G
P393	Olney-Worlant Variant sandy loams 0-12%			S/G
	40% Olney sandy loams	500-1,100	800	S/G
	40% Worland Variant sandy loam	500-1,100	700	S/G
P396	Tassel-Worland Variant-Rock Outcrop complex, 0-100%			
	35% Tassel			
	30% Worland Variant			
	25% Rock Outcrop			
P398	Tassel-Bowbac-Terry complex 3-30%			S/G
	30% Tassel loamy find sand	200-400	325	G
	25% Bowbac fine sandy loam	225-600	400	S/G
	25% Terry fine sandy loam			
P413A	Sharland clay loam 0-3%	225-600	400	S/G,
P442BC	(g)			
P442BE	Oceanet-Rock Outcrop complex 0-100%			
	50% Oceanet sandy loam	200-400	325	G, S/G
	30% Rock Outcrop			
P469	Keyner-Bowbac-Muffler complex 0-10%	225-600	400	S/G
	30% Keyner fine sandy loam			G
	25% Bowbac sandy loam			S/G
	15% Muffler very fine sandy loam			S/G
P471	Bributte-Persayo-Rock outcrop complex 0-100%	85-250	150	DS
	35% Bributte clay			
	30% Persayo clay loam			
	15% Rock Outcrop			
P471CE	Bributte-Persayo-Pavillion complex 3-60%			
	30% Bributte silty clay loam	200-550	350	DS
	30% Persayo clay loam	200-550	350	DS
	15% Pavillion loam	225-600	400	G, S/G
P54B	Fluvents 0-3%	350-800	525	R
P569	Uffens-Meeteetse-Muff complex 0-10%	200-550	350	DS
	30% Uffens sandy loam			
	30% Meeteetse loam			
	20% Muff loam			
P570AD	(f)			
P601	Youngston-Uffens complex 0-6%	250-500	350	DS, S/G
	40% Youngston clay loam			
	40% Uffens sandy loam			
P643AD	(f)			
P701	Fort Collins-Kim loams, 3-15%			
	50% Fort Collins loam	500-1,100	800	S/G, DS
	30% Kim loam	500-1,100	800	S/G, DS
P951AC	(f)			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
Bighorn County				
BH1A	Glenton sandy loam 0-3%	1,400-2,400	1,800	R
BHb1A	Las Animas sandy loam 0-3%	1,800-2,600	2,400	R, GW
BHb1B	(g)			
BH4A	Shoshone l 0-3%	1,800-2,600	2,400	R, GW
BHa7A	Dobent l 0-3%	1,800-2,600	2,400	R, GW
BHa7uA	Fluvaquents 0-3%	3,000-6,000	4,500	R
BH11A	Garland-Emblem complex, 0-3%			
	55% Garland clay loam	1,800-2,600	2,400	R, GW, C
	35% Emblem loam	1,800-2,600	2,400	R, GW, C
BH11AC	(g)			
BH15AC	Emblem-Garland complex, 0-10%			
	55% Emblem loam	1,800-2,600	2,400	R, GW
	25% Garland clay loam	1,800-2,600	2,400	R, GW
BH40AC	Arvada loam, 0-10%	275-650	450	DS
BH41A	Stutzman silty clay loam, 0-3%	200-550	300	DS
BHb41AB	Stutzman silty clay loam, wet, 0-3%	800-2,600	2,400	R, C
BH42A	Apron sandy loam, 0-3%	225-600	400	G, S/G, C
BH42C	Apron sandy loam, 6-10%	225-600	400	G, S/G, C
BH42AC	Apron sandy loam, 0-10%	225-600	400	G, S/G
BH43A	Lostwells clay loam 0-3%	225-600	400	G, S/G, C
BHD43	Youngston clay loam, 0-3%	200-550	350	DS, C
BH44sAB	Binton clay loam, wet, 0-6%	1,800-2,600	2,400	R, GW
BH45AB	Lostwells-Youngston, wet 0-6%			
	35% Lostwells clay loam, wet	1,800-2,600	2,400	R, GW, C
	35% Youngston clay loam, wet	1,800-2,600	2,400	R, GW, C
BH47AC	Torchlight sandy clay loam 0-10%	200-550	350	DS
BH48A	Youngston clay loam, mod. wet 0-3%	1,400-2,400	1,800	R, C
BHa51AC	(f)			
BH71	Greybull-Deaver clay loam 0-3%			
	40% Greybull clay loam	200-550	350	DS, C
	40% Deaver silty clay	200-550	350	DS, C
BH71BC	Greybull-Deaver clay loam 3-10%			
	40% Greybull clay loam	200-550	350	DS, C
	40% Deaver silty clay	200-550	350	DS, C
BH72BC	Worland sandy loam 3-10%	225-600	400	G, S/G, C
BH90	(g)			
BH90A	Persayo-Bributte-Chipeta complex, 0-10%			
	45% Persayo clay loam	200-550	350	DS, C
	24% Bributte clay loam	200-550	350	DS, C
	15% Chipeta silty clay	200-550	350	DS, C
BH90BC	(g)			
BH101	Aquepts, nearly level 0-10%			
BH102	Badland 0-100%			
BH103	Rock Outcrop 0-100%			
BH112	Riverwash 0-10%			
BH120	(f)			
BH301A	(f)			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
BH303A	Shoshone-Willwood complex 0-3%			
	50% Shoshone loam	1,800-2,600	2,400	R, GW, C
	35% Willwood gravelly sandy loam	1,400-2,400	1,800	R, C
BH304A	(f)			
BH305A	(f)			
BH306A	Willwood-Glenton complex 0-3%			
	55% Willwood very cobbly loamy sand	1,400-2,400	1,800	R, C
	30% Glenton sandy loam	1,400-2,400	1,800	R, C
BH315	Preatorson-Worland-Willwood association, steep 3-30%			G, S/G
	30% Preatorson gravelly fine sandy loam	150-350	250	G, S/G
	25% Worland sandy loam	225-600	400	G, S/G, C
	15% Willwood gravelly sandy loam	1,400-2,400	1,800	R, C
BH317	Mudray Variant-Muff-Bributte complex 0-10%			DS
	40% Mudray Variant sandy loam	200-550	350	DS
	25% Muff fine sandy loam	200-550	350	DS
	15% Bributte silty clay loam	200-550	350	DS
BH343AC	Enos-Wallson-Worland complex 0-15%			G, S/G
	40% Enos loamy fine sand	225-600	400	G, S/G
	30% Wallson loamy fine sand	225-600	400	G, S/G
	20% Worland sandy loam	225-600	400	G, S/G
BH351AC	Lostwells clay loam, alkali 0-10%	200-550	350	DS
BH363AC	Binton-Youngston clay loam			
	50% Binton clay loam	200-550	350	DS
	30% Youngston clay loam	200-550	350	DS
BH363AD	(g)			
BH368AC	Lostwells-Kinnear sandy clay loam, 0-10%			
	40% Lostwells sandy clay loam	225-600	400	G, S/G
	40% Kinnear sandy clay loam	225-600	400	G, S/G
BH371AD	Greybull-Persayo association, rolling 0-30%			DS
	50% Greybull clay loam	200-550	350	DS
	30% Persayo clay loam	200-550	350	DS
BH372AD	(g)			
BH372CD	Worland-Persayo complex 6-45%			
	45% Worland sandy loam	225-600	400	G, S/G
	30% Persayo clay loam	200-550	350	DS
BH373AB	Cestnik-Lostwells, 0-6%			
	40% Cestnik silty clay loam	250-500	350	DS
	30% Lostwells clay loam	225-600	400	G, S/G, C
BH374CE	Chipeta-Persayo-Rock Outcrop complex, 6-90%			
	40% Chipeta silty clay	85-250	150	DS
	20% Persayo clay loam	85-250	150	DS
	15% Rock outcrop			
BH409-A	Glenton-Baroid sandy loam, wet 0-3%			
	30% Glenton sandy loam, wet	1,400-2,400	1,800	R, C
	30% Baroid sandy loam, wet	1,800-2,600	2,400	R, GW, C
BH413A	Sharland clay loam, 0-3%	225-600	400	G, S/G, C
BH413AC	Sharland clay loam, 0-3%	225-600	400	G, S/G
BH413jA	Sharland clay loam, wet 0-3%			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
BH467BD	Pavillion-Kinnear-Persayo Association, rolling, 0-45%			
	45% Pavillion sandy clay loam	225-600	400	G, S/G
	25% Kinnear clay loam	225-600	400	G, S/G
	20% Persayo clay loam	200-550	350	OS
BH468AC	Kinnear-Uffens-Rock Outcrop complex, 0-30%			
	40% Kinnear clay loam	225-600	400	G, S/G
	35% Uffens loam	200-550	350	DS
	15% Rock Outcrop			
BH471CE	Bributte-Persayo-Pavillion association, 3-60%			
	30% Bributte silty clay loam	85-250	150	DS
	30% Persayo clay loam	85-250	150	OS
	15% Pavillion loam	225-600	400	G, S/G
BH472AD	Worland-Oceanet complex 3-30%			
	50% Worland sandy loam	225-600	400	G, S/G
	40% Oceanet loamy fine sand	200-400	325	G, S/G
BH472CE	(g)			
BH474AD	Chipeta-Deaver-Stutzman complex, 0-30%			
	40% Chipeta silty clay	85-250	150	DS
	30% Deaver silty clay	200-550	350	DS, C
	20% Stutzman silty clay loam	200-550	300	OS
BH476	(f)			
BH493BD	Emblem-Griffy-Preatorson complex 1-30%			
	40% Emblem sandy loam	225-600	400	G, S/G
	25% Griffy sandy loam	225-600	400	G, S/G
	20% Preatorson gravelly sandy loam	150-350	250	G, S/G
BH511A	(f)			
BH548-A	Fluvents 0-3%			
BH570AD	Muff-Uffens-Persayo complex 0-30%			OS
	35% Muff fine sandy loam	200-550	350	OS
	25% Uffens loam	200-550	350	OS
	20% Persayo clay loam	200-550	350	OS
BH572CE	Oceanet-Rock Outcrop complex 10-60%			G, S/G
	50% Oceanet loamy fine sand	200-400	325	G, S/G
	30% Rock Outcrop			
BH601	Youngston-Uffens complex 0-10%			DS
	40% Youngston clay loam	200-550	350	OS
	40% Uffens loam	200-550	350	DS
BH643	(f)			
Washakie County				
2	Apron Sandy Loam, 0-3%	225-600	375	S/G, C
4	Apron-Worland sandy loam, 1-12%	225-600	375	S/G
7	Baroid sandy loam	1,400-2,400	1,800	R, C
8	Baroid-Las Animas Variant sandy loam	1,400-2,400	1,800	R, C
		1,800-2,600	2,400	R, GW, DS, C
14	Clifterson-Persayo association	100-300	200	S/G
		200-550	350	OS
		225-600	350	S/G

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
16	Dobent loam	1,800-2,600	2,400	R, GW, C
19	Fluvaquents	3,000-6,000	4,500	R
20	Fluvents	1,400-2,400	1,800	R
21	Forkwood-Haverdad association	500-1,100	800	S/G
		600-1,200	900	GW
		275-650	450	DS
22	Forkwood-Kishona association	500-1,000	800	S/G
		600-1,200	900	GW
23	Fruita-Neiber association	225-600	365	S/G
		200-550	350	DS
25	Glenton sandy loam, mod wet	1,400-2,400	1,800	R, C
26	Glenton-Baroid sandy loam, wet	1,800-2,600	2,400	GW, C
29	Greybull-Persayo clay loam, 3-10%	200-550	350	DS, C
30	Greybull-Persayo association	200-550	350	DS
31	Griffy sandy loam, 1-10%	225-600	375	S/G
32	Griffy clay loam, 0-3%	225-600	365	S/G, C
33	Hoot-Rock outcrop complex, 3-45%	225-500	375	S/G
		200-550	350	DS
34	Kishona-Shingle-Rock outcrop association	225-600	365	S/G
		350-700	500	S/G
40	Lostwells clay loam, 0-3%	225-600	365	S/G, C
41	Lostwells clay loam, 3-6%	225-600	365	S/G
42	Lostwells-Youngston complex, 1-10%	225-600	365	S/G
		200-550	350	DS
43	Lostwells-Youngston complex, wet, 0-6%	1,800-2,600	2,400	R, GW, C
		225-600	365	S/G, C
46	Muff-Neiber fine sandy loam, 3-30%	200-550	350	DS
		225-600	375	S/G
56	Persayo-Muff-Rock outcrop association	200-550	350	DS
57	Persayo-Rock outcrop association	85-300	175	DS
60	Riverwash			
61	Rock outcrop-Persayo complex, 15-70%	85-300	175	DS
66	Stutzman sandy clay loam, , 0-3%	200-550	350	DS, C
67	Stutzman sandy clay loam, wet, 0-3%	1,800-2,600	2,400	R, GW, C
70	Uffens-Persayo complex, 1-30%	200-550	350	DS
71	Uffens-Rairdent complex, 1-10%	200-550	350	DS
		225-600	365	S/G
		225-600	375	S/G
73	Wallson loamy fine sand, 1-10%	225-600	375	S/G
74	Wallson sandy loam, 3-6%	225-600	375	s/G, C
81	Youngston clay loam, mod wet, 0-3%	1,400-2,400	1,800	R, C
82	Youngston sandy clay loam, 0-3%	200-550	350	DS, C
83	Youngston-Glenton complex, 0-3%	350-800	525	GW
		1,400-2,400	1,800	R
		225-600	365	S/G
84	Youngston-Uffens-Lostwells complex, 1-10%	200-550	350	DS
Hot Springs County Area				
HS68	Cadoma-Epsie complex, 3-45%			
	50% Cadoma silty clay loam	275-650	450	DS
	25% Epsie silty clay	275-650	450	DS

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
HS73	Absted-Stoneham-Ulm loam, 3-10%			
	40% Absted loam	500-1,100	800	G, S/G
	30% Stoneham loam	500-1,100	800	G, S/G
	20% Ulm loam	500-1,100	800	G, S/G
HS91C	Neville loam, 6-10%			
HS102	Rock Outcrop, very steep 30-100%			
HS103	(f)			
HS111	Rock Outcrop-Shingle-Tassel complex			
	30% Rock Outcrop			
	25% Shingle loam	350-700		G, S/G, C
	25% Tassel sandy loam	350-700		G, S/G, C
HS243	Kim alkali-Kim loam 0-6%			
	50% Kim alkali loam	600-1,200		R, GW
	30% Kim loam			
HS322	Nihill-Shingle gravelly loam 0-45%			
	45% Nihill gravelly loam	100-450		G
	30% Shingle gravelly loam	350-700		G
HS360	Stoneham-Kim association 0-8%			
	50% Stoneham loam	500-1,100		G
	30% Kim loam	500-1,100		G
HS389	Spearfish-Neville association 1-45%			
	50% Spearfish very fine sandy loam	350-700		G, S/G
	30% Neville very fine sandy loam	500-1,100		G, S/G
HS398	Tassel-Bowbac-Terry complex 3-30%			
	30% Tassel sandy loam	350-700		G, S/G
	25% Bowbac fine sandy loam	500-1,100		G, S/G
	25% Terry fine sandy loam	500-1,100		G, S/G
HS448	Torrifluvents, saline 0-6%			GW, R, DS,
HS450	Torrifluvents-Fluvaquents complex 0-6%			R, S/G, G,
HS490	Shingle-Thedalund loam 0-45%			
	40% Shingle loam	350-700		S/G, G
	35% Thedalund loam	500-1,100		S/G, G
HS671	Rock Outcrop-Persayo complex 3-60%			
	50% Rock Outcrop			
	35% Persayo	85-250	150	DS
HS700	Stoneham-Cushman loam 3-15%			
	50% Stoneham loam	500-1,100	800	G, S/G
	30% Cushman loam	500-1,100	800	G, S/G
HS703	Fort Collins-Cushman loam 3-15%			
	50% Fort Collins loam	500-1,100	800	G, S/G
	30% Cushman loam	500-1,100	800	G, S/G
HS705	Kim-Thedalund loam 3-15%			
	50% Kim loam	500-1,100	800	G, S/G
	30% Thedalund loam	500-1,100	800	G, S/G
HS708	Renohill-Cushman-Worfka complex 3-20%			
	40% Renohill clay loam	500-1,100	800	G
	20% Cushman loam	500-1,100	800	G, S/G
	20% Worfka loam	350-700	500	S/G, G
HS709	Renohill-Cadoma-Worfka complex 0-20%			
	40% Renohill clay loam	500-1,100	800	DS, G
	25% Cadoma Silty clay loam	275-650	450	DS
	20% Worfka loam	350-700	500	S/G, G

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
HS720	Blazon-Rock Outcrop complex 3-60%			
	45% Blazon loam	350-700	500	S/G, G
	30% Rock Outcrop			
HS722	Blazon loam 3-45%	350-700	500	S/G, G
HS723	Blazon-Delphill loam			
	40% Blazon loam	350-700	500	S/G, G
	35% Delphill loam	500-1,100	800	G, S/G
HS725	Blazon-Diamondville loam 3-30%			
	40% Blazon loam	350-700	500	S/G, G
	35% Diamondville loam	500-1,100	800	G, S/G
HS735	Patent-Forelle association, 3-15%			
	45% Patent loam	500-1,100		G, S/G
	35% Forelle loam	500-1,100		G, S/G
HS736	Forelle-Pinelli loam, 3-15%			
	50% Forelle loam	500-1,100		G, S/G
	30% Pinelli loam	500-1,100		G, S/G
HS753	Gaynor-Samsil clay 3-15%			
	40% Gaynor clay	500-1,100	800	DS, G
	40% Samsil clay	350-700	500	G, S/G
HS902	Samsil-Shingle-Rock Outcrop complex 3-45%			
	50% Samsil clay	350-700	500	G, S/G
	20% Shingle loam	350-700	500	S/G, G
	15% Rock Outcrop			
HS910	Cadoma-Thedalund-Epsie complex 3-45%			
	30% Cadoma silty clay loam	275-650		DS
	25% Thedalund loam	500-1,100		S/G
	25% Epsie silty clay	275-650		DS
HS930	Rentsac Variant-Rentsac-Clayburn Variant complex, 3-90%			
	40% Rentsac Variant	500-1,100	800	S/G
	30% Rentsac channery loam	250-500	350	MX
	15% Clayburn Variant	500-1,100	800	S/G
HS931	Clayburn Variant-Rentsac Variant complex, 3-20%			
	45% Clayburn Variant	500-1,100	800	S/G
	35% Rentsac Variant	500-1,100	800	S/G
Fremont County, Eastern part				
F2g11	Emblem-Clifsand-Rairdent complex, 1-25%			
	30% Emblem sandy loam	225-600	400	S/G
	30% Clifsand very gravelly loam	100-300	200	S/G, G
	30% Rairdent loam	225-600	400	S/G
F2n11	Clifsand-Persayo complex, hilly			
	45% Clifsand gravelly loam	100-300	200	G, S/G
	30% Persayo loam	125-350	250	DS
F102	Badland-Birdsley complex, steep			
	50% Badland			
	30% Birdsley sandy clay loam	100-300	200	DS

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
F103	=F230			
F104	(f)			
F105	Rock outcrop-Blazon complex, hilly			
F206	Youngston-Lostwells complex, 1-3%			
	50% Youngston clay loam	200-500	300	S/G
	35% Lostwells loam	225-600	400	S/G
F206F	Youngston-Lostwells-Apron complex, 0-3%			
	35% Youngston loam, occasionally flooded	700-1,600	1,200	R, GW
	30% Lostwells loam	225-600	400	S/G
	20% Apron sandy loam	225-600	400	S/G
F218	Griffy-Saddle-Wallson Association, undulating	225-600	400	S/G
	35% Griffy sandy loam			
	35% Saddle sandy loam			
	15% Wallson loamy fine sand			
F230	Thermopolis-Sinkson association, hilly			
	60% Thermopolis loam	350-700	500	S/G
	20% Sinkson loam	500-1,100	800	S/G
F231	Crago-Pensore association, undulating	350-700	500	S/G
	60% Crago gravelly loam			
	20% Pensore very channery sandy clay loam			
F234	Sinkson-Almy-Thermopolis association, hilly			
	45% Sinkson loam	500-1,100	800	S/G
	20% Almy loam	500-1,100	800	S/G
	20% Thermopolis loam	350-700	500	S/G
F237	Uffens-Muff-Frisite loam, 1-12%			
	35% Uffens loam	200-400	300	DS
	30% Muff loam	200-400	300	DS
	15% Frisite loam	225-600	400	S/G
F242	Apron-Lostwells complex, 0-10%			
	45% Apron sandy loam	225-600	400	S/G
	40% Lostwells loam	225-600	400	S/G
F245	(f)			
F248	Frisite-Youngston complex, 1-8%			
	60% Frisite fine sandy loam	225-600	400	S/G
	20% Youngston loam	200-500	300	S/G
F271	Persayo-Rock outcrop complex, hilly			
	65% Persayo clay loam	125-350	250	DS
	15% Rock outcrop			
F272	Blackhall-Carmody association, hilly			
	45% Blackhall fine sandy loam	700-1,200	900	S/G
	35% Carmody fine sandy loam	700-1,500	1,200	G, S/G
F274	Oceanet-Rock Outcrop-Persayo complex, hilly			
	Oceanet	125-350	250	G
	Persayo	125-350	250	DS
F277	Diamondville-Forelle association, rolling	600-1,400	1,100	S/G
	50% Dianondville loam			
	30% Forelle loam			

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
F294	Forelle-Poposhia association, 2-12%			
	45% Forelle loam	600-1,400	1,100	S/G
	40% Poposhia loam	500-1,300	1,000	S/G
F297	Birdsley-Mudray complex, 3-15%	100-300	200	DS
	55% Birdsley, sandy clay loam			
	30% Mudray sandy loam			
F298	Blazon-Rock outcrop-Carmody complex, hilly			
	50% Blazon clay loam	500-1,000	800	G
	20% Rock outcrop			
	15% Carmody gravelly sandy loam	700-1,500	1,200	G, S/G
F301	Binton-Youngston, 0-3%			
	45% Binton Clay loam	700-1,600	1,200	R, GW
	40% Youngston clay loam	200-500	300	S/G
F306	Youngston-Effington loam, 0-6%			
	Youngston loam	200-500	300	S/G
	Effington			
F342	Apron-Wallson-Worland Association, 1-15%	225-600	400	S/G
	35% Apron loamy sand			
	30% Wallson sandy loam			
	20% Worland loamy sand			
F348	Frisite-Emblem loam, 1-8%	225-600	400	S/G
	45% Frisite loam			
	35% Emblem loam			
F374	(f)			
F375	Worland-Oceanet-Persayo Association, rolling			
	40% Worland sandy loam	225-600	400	S/G
	20% Oceanet sandy loam	125-350	250	G
	15% Persayo silty clay loam	125-350	250	DS
F406	Youngston-Persayo loam, rolling			
	60% Youngston loam	200-500	300	S/G
	25% Persayo loam	125-350	250	DS
Natrona County				
112	Arvada-Absted-Slickspots complex, 0-6%			
	Arvada	350-700	500	DS
	Absted	600-1,400	1,100	S/G
117	Badland			
130	Bosler-Alcova complex, 2-10%	600-1,400	1,100	S/G
132	Bowbac-Hiland fine sandy loam, 3-10%	600-1,400	1,100	S/G, C
140	Cadoma-Renihill-Samday clay loam, 3-12%			
	Cadoma	350-700	500	G
	Renihill	500-1,300	1,000	S/G
	Samday	200-400	300	DS
175	Dune Land			
178	Effington-Uffens complex 0-6%	100-300	200	DS
179	Enos-Wallson association, rolling	225-600	400	S/G

Table 2-14. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
187	Forkwood-Ulm complex, 0-6%			
	Forkwood	600-1,400	1,100	S/G
	Ulm	500-1,300	1,000	S/G
188	Forkwood-Zigweid association, sloping	600-1,400	1,100	S/G
190	Griffy sandy loam, 2-15%	225-600	400	S/G
191	Griffy-Emblem fine sandy loam, 0-6%			
	Griffy	225-600	400	S/G
	Emblem	125-350	250	S/G
195	Haverdad-Clarkelen complex, saline, 0-3%	1,200-2,500	1,800	R, GW
201	Hiland sandy loam, 0-6%	600-1,400	1,100	S/G
209	Keyner-Absted-Slickspots complex, 0-6%	600-1,400	1,100	S/G
214	Lolite-Rock outcrop complex 10-40%	200-400	300	DS
222	Mudray-Bributte-Birdsley complex, 6-30%	200-400	300	DS
226	Oceanet-Persayo complex, 6-30%			
	Oceanet	125-350	250	G
	Persayo	125-350	250	S/G, DS
227	Orella-Cadoma-Petrie clay loam, 3-30%	350-700	500	DS
228	Orella-Rock outcrop complex, 3-30%	350-700	500	DS
229	Orpha loamy sand, 10-30%	1,400-2,200	2,000	G
232	Persayo-Greybull association, gently rolling and hilly			
	Persayo	125-350	250	S/G, DS
	Greybull	225-600	400	S/G
264	Roughlock loam, 0-6%	850-2,000	1,500	G
270	Saddle-Griffy association, rolling	225-600	400	S/G
275	Shingle-Taluce-Rock outcrop complex, 10-40%			
	Shingle	700-1,200	900	S/G
	Taluce	700-1,200	900	G
276	Shingle-Theedle association, rolling			
	Shingle	700-1,200	900	S/G
	Theedle	600-1,400	1,100	S/G
278	Silhouette-Petrie clay loam, 1-6%			
	Silhouette	500-1,300	1,000	S/G
	Petrie	350-700	500	DS
282	Terro-Vonalee association, rolling	700-1,500	1,200	G
283	Theedle-Shingle-Kishona complex, 6-40%			
	Theedle	400-1,100	900	S/G
	Shingle	700-1,200	900	S/G
	Kishona	600-1,400	1,100	S/G
289	Typic torrifluvent 0-3%			
290	Uffens, thick surface-Uffens very fine sandy loam, 0-6%	225-600	400	S/G
291	Uffens, overflow-Typic torrifluvents Complex, 0-3%	700-1,600	1,200	R, GW, G
293	Ulm-Absted complex, 0-6%	500-1,300	1,000	S/G
301	Vonalee-Hiland complex, 3-15%			
	Vonalee	700-1,500	1,200	G
	Hiland	600-1,400	1,100	S/G
310	Zigweid loam, 2-9%	600-1,400	1,100	S/G
311	Zigweid-Theedle loam, 3-15%	700-1,500	1,200	S/G

Table 2-14. Continued.

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a = For Data Sources see Table 2-1.
b = Range = Unfavorable years to favorable years; normal = median years.
c = Based on soil unit description and/or range site designation and description.
S/G = Sagebrush/Grassland, DS = Desert Shrub; G = Grassland;
CW = Coniferous Woodland; C = Cropland; R = Riparian; GW = Greasewood subtype of Riparian;
MX = Mixed Shrub.
d = % = percent slope.
e = Dry years and moist years with vegetation in excellent condition; no normal available.
f = Soil units are indicated on draft map but no soil unit name or description is available.
g = See unit name and description with similar number; letters indicate:
A = 0-3% slope, B = 3-6%, C = 6-10%, D = 10-15%
j = Slightly wet, may be due to irrigation seepage, u = Very wet.

Table 2-15. Taxonomic Classification of Elk Basin Soil Series. (a)

Series	Taxonomic Classification
Absted	Fine, montmorillonitic, mesic Haplustollic Natrargids
Alcova	Fine-loamy, mixed, Borollic Haplargids
Aldrich	Fine, montmorillonitic (calcareous), mesic Typic Torriorthents
Almy	Fine-loamy, mixed Borollic Haplargids
Amodac	Fine-loamy, mixed, mesic Ustollic Camborthids
Apron	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Baroid	Sandy, mixed, mesic Typic Torrifluvents
Binton	Fine-loamy, mixed (calcareous, mesic Typic Torrifluvent
Birdsley	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Blackdraw	Fine, mixed, nonacid, mesic Ustic Torriorthents
Blackhall	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Blazon	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent
Bosler	Fine-loamy over sandy or sandy-skeletal, mixed Borollic Haplargids
Bowbac	Fine-loamy, mixed, mesic Ustollic Haplargids
Bributte	Clayey, montmorillonitic (calcareous), mesic, shallow Typic Torriorthents
Cadoma	Fine, montmorillonitic, mesic Ustollic Camborthids
Carmody	
Cesnik	Clayey over sandy or sandy-skeletal, montmorillonitic (calcareous), mesic Typic Torriorthents
Chipendale	Fine, mixed, mesic Cambic Gypsiorthids
Chipenhill	Clayey, mixed (calcareous), mesic, shallow Typic Torriorthents
Chipeta	Clayey, mixed (calcareous), mesic, shallow Typic Torriorthents
Clarkelen	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Clayburn Variant	Fine-loamy, mixed Pachic Haploboroll
Clifsand	
Clifterson	Loamy-skeletal, mixed (calcareous), mesic Typic Torriorthents
Colby	Fine-silty, mixed (calcareous), mesic Ustic Torriorthents
Copeman	Fine-loamy, mixed, mesic Ustollic Calciorthids.
Crago	Loamy-skeletal, carbonatic Borollic Calciorthids
Cushman	Fine-loamy, mixed, mesic Ustollic Haplargids
Deaver	Fine, Montmorillonitic (calcareous), mesic Typic Torriorthents
Delphill	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents
Diamondville	Fine-loamy, mixed Borollic Haplargid
Dobent	Fine-loamy, mixed (calcareous), mesic Typic Fluvaquents
Effington	Fine, montmorillonitic, mesic Typic Natrargids
Emblem	Fine-loamy, over sandy or sandy-skeletal, mixed, mesic Typic Calciorthids
Enos	Coarse-loamy, mixed, mesic Typic Haplargid
Epsie	Clayey, montmorillonitic (calcareous) mesic, shllw Ustic Torriorthent
Forelle	Fine-loamy, mixed Borollic Haplargid
Forkwood	Fine-loamy, mixed, mesic Ustollic Haplargids
Forkwood Variant	Fine-loamy, mixed, mesic Ustollic Haplargids
Fort Collins	Fine-loamy, mixed, mesic Ustollic Haplargids
Frisite	Fine-loamy, mixed, mesic Typic Haplargids
Frontier	Loamy, mixed, mesic Lithic Ustollic Haplargids
Fruita	Fine-loamy, mixed, mesic Typic Haplargids
Garland	Fine-Loamy over sandy or sandy-skeletal, mixed, mesic Typic Haplargids
Gaynor	Fine, montmorillonitic (calcareous), mesic Ustic Torriorthents
Glenton	Coarse-loamy, mixed, (calcareous), mesic Typic Torrifluvents
Greybull	Fine-loamy, mixed (calcareous), mesic Typic Torriorthents
Griffy	Fine-loamy, mixed, mesic Typic Haplargids
Harvey	Fine-loamy, mixed, mesic Ustollic Calciorthids
Haverdad	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents

Table 2-15. Continued.

Series	Taxonomic Classification
Haverson	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Heldt	Fine, montmorillonitic, mesic Ustertic Caborthids
Hiland	Fine-loamy, mixed, mesic Ustollic Haplargids
Hoot	Loamy-skeletal, mixed, mesic Lithic Haplargids
Irson	Loamy-skeletal, mixed Lithic Cryoborolls
Kather	Fine, montmorillonitic Borollic Haplargids
Keeline	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Keyner	Fine loamy, mixed, mesic Haplustollic Natrargids
Kezar	
Kim	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthent
Kinnear	Fine-loamy, mixed, mesic Typic Camborthid
Kishona	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthent
Kyle	Very-fine, montmorillonitic, mesic Ustertic Camborthids
Las Animas	Coarse-loamy, mixed (calcareous), mesic Typic Fluvaquents
Las Animas Variant	Coarse-loamy, mixed (calcareous), mesic Typic Fluvaquents
Lismas	Clayey montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents
Lolite	Clayey, mixed, nonacid, mesic, shallow Typic Torriorthents
Lonebear	Fine, mixed, mesic Cambic Gypsiorthids
Lostwells	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Lupinto	Loamy-skeletal, mixed Borollic Haplargids
Meeteetse	Fine, montmorillonitic, mesic Typic Natrargids
Middlewood	Clayey, montmorillonitic Borollic Lithic Haplargids
Midway	Clayey, montmorillonitic (calcareous) mesic, shallow Ustic Torriorthents
Mudray	Clayey, montmorillonitic, mesic, shallow Tylpic Natrargids
Mudray Var	Clayey, montmorillonitic, mesic, shallow Typic Natrargid
Muff	Fine-loamy, mixed, mesic Typic Natrargid
Muffler	Fine-loamy, mixed, mesic Typic Natrargid
Neiber	Fine-loamy, mixed, mesic Typic Haplargids
Neville	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthent
Nihill	Loamy-skeletal, mixed (Calcareous), mesic Ustic Torriorthent
Oceanet	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Olney	Fine-loamy, mixed, mesic Ustollic Haplargid
Orella	Clayey, mixed (calcareous), mesic, shallow Ustic Torriorthents
Orpha	Mixed, mesic Ustic Torripsamments
Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthent
Patent	Fine-loamy, mixed (calcareous), frigid UStic Torriorthent
Pavillion	Fine-loamy, mixed, mesic, Typic Camborthids
Pensore	Loamy-skeletal, carbonatic Borollic Lithic Calciorthids
Persayo	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthent
Petrie	Fine, montmorillonitic (calcareous), mesic Ustertic Torriorthent
Pinelli	Fine, montmorillonitic Borollic Haplargid
Poposhia	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents
Preatorson	Loamy-skeletal, mixed, mesic, Typic Haplargids
Rairdent	Fine-loamy, mixed, mesic Cambic Gypsiorthids
Renohill	Fine, montmorillonitic, mesic Ustollic Haplargids
Rentsac	Loamy-skeletal, mixed (calcareous), frigid Lithic Ustic Torriorthents
Rentsac Variant	Fine-loamy, mixed Aridic Argiborolls
Riverwash	Calciorthids
Roughlock	Coarse-silty, mixed, mesic Ustollic Calciorthids
Saddle	Fine-loamy, mixed, mesic Typic Haplargids
Samday	Clayey, montmorillonitic (calcareous), mesic, shallow Ustic Torriorthents

Table 2-15. Continued.

Series	Taxonomic Classification
Samsil	Clayey montmorillonitic (clcrs) mesic, shllw Ustic Torriorthent
Sharland	Fine-loamy over sand or sandy-skeletal, mixed mesic Typic Haplargids
Shingle	Loamy, mixed, (calcareous), mesic, shallow Ustic Torriorthents
Shoshone	Coarse-loamy, mixed (calcareous), mesic Typic Fluvaquents
Silhouette	Fine, montmorillonitic, mesic Ustollic Camborthids
Silvertip	Fine-loamy, mixed, mesic Ustollic Haplargids
Sinkson	
Spearfish	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthent
Spomer	Fine-loamy over sandy or sandy skeletal, mixed, mesic Ustollic Haplargids
Stoneham	Fine-loamy, mixed, mesic Ustollic Haplargid
Stutzman	Fine, montmorillonitic (calcareous), mesic Typic Torriorthents
Taluce	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthent
Terro	Coarse-loamy, mixed, mesic Ustollic Haplargids
Terry	Coarse-loamy, mixed, mesic Ustollic Haplargid
Thedalund	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthent
Theedle	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Thermopolis	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthent
Threetop	Fine-loamy, mixed, mesic Ustollic Haplargids
Tonra	Fine-loamy, over sndy or sndy-skeletal, mxd, mesic Ustollic Calciorthids
Torchlight	Fine, montmorillonitic (calcareous), mesic Vertic Torriorthents
Travessilla	Loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents
Uffens	Fine-loamy, mixed, mesic Typic Natrargids
Ulm	Fine, montmorillonitic, mesic Ustollic Haplargid
Vanda	Fine, montmorillonitic (calcareous), Frigid Ustic Torriorthents
Vonalee	Coarse-loamy, mixed, mesic Ustollic Haplargids
Wallson	Coarse-loamy, mixed, mesic Typic Haplargid
Willwood	Sandy-skeletal, mixed, mesic, Typic Torriorthents
Willwood Variant	
Winnett	Fine, montmorillonitic, mesic Ustollic Natrargids
Worfka	Clayey, montmorillonitic, mesic, shallow Ustollic Haplargid
Worfman	Loamy, mixed, shallow Borollic Haplargids
Worland	Coarse-loamy, mixed, (calcareous), mesic Typic Torriorthents
Worland Variant	Coarse-loamy, mixed, (calcareous), mesic Ustic Torriorthents
Youngston	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Zigweid	Fine-loamy, mixed, mesic Ustollic Camborthids

a = Source: Soil Conservation Service series descriptions (form 5);
additional sources in Table 2-1.

Table 2-16. Vegetation Disturbed During Construction of the Elk Basin CO2 Project. (a)

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Description
Field Facilities (b)		682.5	Undetermined	
Recycle Plant		40.0	Sagebrush/Grassland	
Meter Station		0.2	Sagebrush/Grassland	
		N.D.	Disturbed	Existing facilities area
0 - 3.0	2.2	20.0	Sagebrush/Grassland and	
	0.8	7.3	Grassland	
3.0 - 8.0	5.0	45.5	Sagebrush/Grassland	Hommocks of sagebrush with grassland interspersed
8.0 - 8.9	0.9	8.2	Grassland	
8.9 - 11.0	2.1	19.1	Mixed Shrub	Dissected topography; particularly steep at milepost 9
11.0 - 12.4	1.4	12.7	Desert Shrub	
12.4 - 12.7	0.3	2.7	Mixed Shrub	Frannie Canal crossed at milepost 12.7
12.7 - 16.2	2.4	21.8	Desert Shrub and	Includes .1 mile of prime farmland soils
	1.1	10.0	Mixed Shrub	
Block valve		0.1	Mixed Shrub	
Road crossing bore pits		1.1	Desert Shrub	
16.2 - 16.5	0.3	2.7	Cropland	Includes .2 mile of prime farmland soils
16.5 - 17.5	1.0	9.1	Mixed Shrub	Includes .4 mile of prime farmland soils
17.5 - 18.2	0.7	6.4	Cropland	
18.2 - 19.4	1.2	10.9	Desert Shrub	
19.4 - 19.6	0.2	1.8	Riparian	Bitter Creek; Big sagebrush with occasional trees; includes .2 mi. prime farmland soils
19.6 - 20.6	1.0	9.1	Sagebrush/Grassland	Includes .1 mile of prime farmland soils
Road crossing bore pits		1.1	Sagebrush/Grassland	
20.6 - 20.7	0.1	0.9	Riparian	Sidon Canal; mostly grass with occasional Russian olive
				Shoshone River; few Cottonwoods and Coyote willow, Greasewood and Big Sagebrush north, and willows, Rabbitbrush, Big sagebrush, Skunkbush sumac and herb mix south of river Russian olive, tamarisk, and small cattail marsh in vicinity
Sidon Canal Bore Pit		1.1	Riparian	
Shoshone River staging area		2.3	Riparian	
20.7 - 21.2	0.5	4.6	Cropland	Includes .4 mile of prime farmland soils
21.2 - 21.3	0.1	0.9	Sagebrush/Grassland	
21.3 - 21.6	0.3	2.7	Desert Shrub	
21.6 - 22.1	0.5	4.6	Riparian	Grassy channel with Big sagebrush and occasional Russian olive with Desert Shrub
22.1 - 23.4	1.3	11.8	Desert Shrub	
23.4 - 23.6	0.2	1.8	Cropland	Prime farmland soils
23.6 - 24.0	0.4	3.6	Desert Shrub	Prime farmland soils
24.0 - 24.2	0.2	1.8	Riparian	Small trees associated with ditch; includes .1 mile of prime farmland soils
24.2 - 24.3	0.1	0.9	Cropland	Includes .1 mile of prime farmland soils
24.3 - 24.6	0.3	2.7	Desert Shrub	Includes .1 mile of prime farmland soils
24.6 - 25.2	0.6	5.5	Cropland	Includes .1 mile of prime farmland soils
25.2 - 25.4	0.2	1.8	Desert Shrub	
25.4 - 25.9	0.5	4.6	Cropland	Includes .5 mile of prime farmland soils
25.9 - 26.0	0.1	0.9	Desert Shrub	
26.0 - 26.4	0.4	3.6	Cropland	
26.4 - 27.2	0.8	7.3	Desert Shrub	
Block valve		0.1	Desert Shrub	
27.2 - 27.3	0.1	0.9	Riparian	Grass Creek; dense sagebrush and grass and an irrigation canal
27.3 - 27.7	0.4	3.6	Desert Shrub	
27.7 - 28.0	0.3	2.7	Riparian	Whistle Creek; sandy creek with sagebrush and occasional trees, mostly Russian olive
28.0 - 29.3	1.3	11.8	Desert Shrub	
29.3 - 29.7	0.4	3.6	Barren/Badlands	Very dissected and steep
29.7 - 32.3	1.9	17.3	Sagebrush/Grassland and	
	0.7	6.4	Desert Shrub	

Table 2-16. Continued.

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Description
32.3 - 32.5	0.2	1.8	Riparian	West Fork Creek; incised ephemeral drainage with occasional large shrubs
32.5 - 33.0	0.5	4.6	Desert Shrub	
33.0 - 33.4	0.4	3.6	Barren/Badlands	Very dissected and steep
33.4 - 34.0	0.6	5.5	Sagebrush/Grassland	Mosaic with grassland
34.0 - 35.9	1.9	17.3	Desert Shrub	Eroded, mixed with rock outcrops; dissected by moderately shrubby drainages
35.9 - 36.6	0.7	6.4	Barren/Badlands	Steep badlands; mostly Desert Shrub vegetation
36.6 - 40.0	3.1	28.2	Sagebrush/Grassland	
	0.3	2.7	Desert Shrub	
40.0 - 40.3	0.3	2.7	Riparian	Dry Creek; sandy bottom; herbaceous lower terrace includes Baltic rush near water, and Inland saltgrass, Sideoats grama and Wild licorice; dense Big sagebrush on upper terace
40.3 - 42.6	2.0	18.2	Sagebrush/Grassland and	
	0.3	2.7	Grassland	
Road crossing bore pits		1.1	Sagebrush/Grassland	
42.6 - 43.8	0.6	5.5	Riparian	Wet meadow; may be grazed or cut for hay
	0.6	5.5	Cropland	Includes .2 mile of prime farmland soils
43.8 - 43.9	0.1	0.9	Riparian	Greybull River; narrow tree lined zone with shrub/herb mosaic on north side
Greybull River staging area		2.3	Riparian	and herbaceous community on south; better developed riparian community downstream
43.9 - 44.3	0.4	3.6	Cropland	Includes .2 mile of prime farmland soils
44.3 - 44.7	0.4	3.6	Desert Shrub	
44.7 - 46.9	2.2	20.0	Cropland	Includes 1.3 miles of prime farmland soils
Block valve		0.1	Cropland	
46.9 - 47.0	0.1	0.9	Riparian	Willow Creek; Herbaceous and shrub mosaic
47.0 - 48.4	1.4	12.7	Desert Shrub	
48.4 - 48.6	0.2	1.8	Riparian	St. Joes Canal; mostly herbaceous and shrubby with scattered trees along canal
48.6 - 48.7	0.1	0.9	Desert Shrub	Salt precipitate on surface
48.7 - 48.9	0.2	1.8	Riparian	St. Joes Canal, Webster Creek and pond; mostly herbaceous and shrubby with scattered trees along canal
48.9 - 57.6	5.1	46.4	Desert Shrub	Includes Dorsey Creek and South Fork Creek, steep incised drainages, and other miscellaneous unnamed drainages
	2.7	24.6	Sagebrush/Grassland	
	0.9	8.2	Barren/Badlands	
57.6 - 57.7	0.1	0.9	Riparian	Elk Creek; relatively level terrain in otherwise very steep topography
57.7 - 65.6	7.6	69.2	Desert Shrub	close to cropland at milepost 65, but will not disturb it
	0.3	2.7	Barrens/Badlands	
65.6 - 65.8	0.2	1.8	Riparian	Reservoir Creek; shrubs with scattered trees
65.8 - 67.3	1.5	13.7	Desert Shrub	
Block valve		0.1	Desert Shrub	
67.3 - 67.9	0.6	5.5	Sagebrush/Grassland	
67.9 - 70.4	2.5	22.8	Desert Shrub	Includes ephemeral drainage with dense shrubs at milepost 69.1
70.4 - 71.5	1.1	10.0	Riparian	Fifteenmile Creek; sandy creek with sparse, Big sagebrush and Greasewood along the bank
71.5 - 72.9	1.4	12.7	Desert Shrub	
72.9 - 73.1	0.2	1.8	Riparian	Middle Fork of Fifteenmile Creek; same as above
73.1 - 79.3	3.4	30.9	Desert Shrub and	Dissected topography but not very steep
	2.8	25.5	Sagebrush/Grassland	
79.3 - 80.2	0.9	8.2	Desert Shrub	Badlands topography
80.2 - 85.5	5.3	48.2	Sagebrush/Grassland	
Block valve		0.1	Sagebrush/Grassland	
85.5 - 85.8	0.3	2.7	Cropland	Includes .3 mile of prime farmland soils
85.8 - 86.1	0.3	2.7	Riparian	Big Horn River; Mix of shrubs and herbaceous on north shore with small trees and shrubs following small drainage channels under railroad tracks; south shore lined with shrubs
Bighorn River staging area		2.3	Riparian	
86.1 - 87.4	1.3	11.8	Cropland	Cultivated fields closely follow the River; includes .9 mile of prime farmland soils

Table 2-16. Continued.

Location by Milepost	Disturbance Miles	Acres	Vegetation Type	Description
Road crossing bore pits		1.1	Cropland	
87.4 - 101.7	7.2	65.5	Desert Shrub and	Mosaic of Desert Shrub, Sagebrush and Grassland in a badlands area; dissected with
	7.1	64.6	Sagebrush/Grassland	many incised ephemeral channels with higher sagebrush density
101.7 - 102.1	0.4	3.6	Riparian	Kirby Creek; mosaic of herbaceous and shrub communities with few trees; upper terrace of dense Big sagebrush
102.1 - 123.8	20.6	187.5	Sagebrush/Grassland	Includes several incised ephemeral drainages with little change in vegetation and:
104.5 - 104.7 (c)	0.2	1.8	Riparian	Alkali Creek; dense Greasewood
110.3	0.1	0.9	Riparian	West Kirby Creek; narrow herbaceous community with scattered willows
112.9	0.1	0.9	Riparian	Ackles Fork; incised drainage with herbaceous vegetation and upland species
115.6 - 115.8	0.2	1.8	Riparian	Kirby Creek; narrow mosaic of willows and herbaceous
117.7	0.1	0.9	Riparian	Kirby Creek; very narrow headwaters; herbaceous and shrub mosaic
120.3	0.1	0.9	Riparian	Ephemeral drainage with dense shrubs
120.6 - 120.7	0.1	0.9	Riparian	Bridger Creek; scattered trees
123.2 - 123.3	0.1	0.9	Riparian	South Bridger Creek
123.8	0.1	0.9	Riparian	Greer Draw
Block valve		0.1	Sagebrush/Grassland	
123.8 - 130.0	4.4	40.0	Sagebrush/Grassland and	
	1.8	16.4	Desert Shrub	
Block valve		0.1	Sagebrush/Grassland	
130.0 - 130.7	0.7	6.4	Riparian	Bridger Creek; wide area of herbaceous and shrub mosaic
130.7 - 132.5	1.7	15.5	Desert Shrub	
131.7	0.1	0.9	Riparian	Davis Draw; ephemeral drainage with dense shrubs
132.5 - 132.9	0.3	2.7	Sagebrush/Grassland	
132.6 - 132.7	0.1	0.9	Riparian	Cottonwood Creek; dense shrubs
132.9 - 133.4	0.5	4.6	Desert Shrub	Steep
133.4 - 135.1	1.5	13.7	Sagebrush/Grassland and	
	0.2	1.8	Riparian	Occasional ephemeral drainages with increased shrub density
135.1 - 135.6	0.5	4.6	Cropland	
135.6 - 135.9	0.3	2.7	Sagebrush/Grassland	
135.9 - 136.0	0.1	0.9	Riparian	Badwater Creek; narrow at pipe crossing but widens above and below, pond in vicinity mostly herbaceous vegetation with some willows and other shrubs
136.0 - 153.4	12.5	113.8	Sagebrush/Grassland and	
	3.8	34.6	Desert Shrub	
138.3 - 138.4	0.1	0.9	Riparian	Sand Creek; sandy bottom with very little change from upland vegetation at crossing
144.6 - 144.8	0.2	1.8	Riparian	Two incised ephemeral drainages with sandy bottoms and dense shrubby terraces
149.6 - 149.7	0.1	0.9	Riparian	Sandy bottom with minor increase in shrub density and occasional trees
150.1 - 150.4	0.3	2.7	Riparian	Red Creek; ephemeral drainage with wide grassy bottom
151.3 - 151.6	0.3	2.7	Riparian	Several unnamed ephemeral drainages with increased shrub density;
153.2 - 153.3	0.1	0.9	Riparian	Ephemeral drainage at base of eroded slope; dense shrubs on terrace, herbaceous in bottom
Block valve		0.1	Desert Shrub	
153.4 - 153.5	0.1	0.9	Riparian	Inlet tributary to pond; ephemeral drainage with increase shrub density
153.5 - 166.9	11.5	104.6	Sagebrush/Grassland and	
	1.3	11.8	Grassland	
154.2	0.1	0.9	Riparian	Ephemeral drainage with increased shrub density
154.7 - 154.8	0.1	0.9	Riparian	Ephemeral drainage with increased shrub density
155.4 - 155.5	0.1	0.9	Riparian	Elk Creek; ephemeral drainage with increased shrub density
156.5 - 165.8	0.3	2.7	Riparian	Alkali Creek; branches of ephemeral drainage with increased shrub density
Block valve		0.1	Sagebrush/Grassland	
166.9 - 167.0	0.1	0.9	Riparian	Keg Spring Draw; mostly shrubby in draw, dense shrubs at crossing

Table 2-16. Continued.

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Description
167.0 - 172.9	5.0	45.5	Sagebrush/Grassland and	
	0.9	8.2	Mixed Shrub	Partially steep, eroded drainages but with very little vegetation
Road crossing bore pits		1.1	Sagebrush/Grassland	
172.9 - 173.1	0.2	1.8	Riparian	South Powder River; wide bottom with moderately dense shrubs, some salt precipitate
173.1 - 174.0	0.9	8.2	Sagebrush/Grassland	
174.0 - 174.1	0.1	0.9	Riparian	Wyatt Draw; moderately dense shrubs at base of bluff, some salt precipitate
174.1 - 175.6	1.5	13.7	Sagebrush/Grassland	
175.6 - 175.8	0.2	1.8	Grassland	
175.8 - 176.8	1.0	9.1	Cropland	
Origin Station		0.1	Cropland	
Wellfield Total		682.5	Undetermined (b)	
Pipeline Totals	92.9	889.4	Sagebrush/Grassland (d)	
	52.8	481.9	Desert Shrub (e)	
	3.5	31.8	Grassland	
	9.9	98.1	Riparian (f)	
	9.6	88.7	Cropland (g)	
	5.4	49.2	Mixed Shrub	
	2.7	24.6	Barren/Badlands	
		N.D.	Disturbed	
		14.6	Undetermined (h)	
Project Totals		2360.9		

a = Vegetation derived from Vegetation Maps EB-1 through EB-40.
Minimum mileage length recorded is 0.1 miles, therefore, the width of narrow ephemeral drainages has been exagerated.
b = Estimated disturbance for replacement of production and injection pipelines; location of pipelines is not yet determined.
c = Indented mileages mark locations of riparian areas, usually ephemeral drainages, within the range of another vegetation type.
d = Acreage includes recycle plant, meter station and block valves.
e = Acreage includes block vlaves.
f = Acreage includes staging areas for canal boring and river crossings.
g = Acreage includes origin station and block valves.
h = Acreage is 1.6 miles of undetermined type along trunk pipeline.

Riparian vegetation along the Shoshone River includes a few Cottonwoods and willows and a wide terrace of Greasewood and Big sagebrush north of the river (Vegetation Map 10, milepost 21). South of the river is primarily Cropland, although the south bank is lined with a narrow band of willow, rabbitbrush, Big sagebrush and Skunkbush sumac with a grass/forb understory. Russian olive, tamarisk and a small cattail marsh are also found in the vicinity. The majority of riparian vegetation in the Shoshone River vicinity is along Whistle Creek, south of the river and east of the pipeline route.

Although much of the Greybull River valley has been converted to cropland, there is more riparian vegetation along the Greybull than along the Shoshone River. At the Greybull River crossing, however, the Riparian vegetation zone is very narrow with a shrub/herb mosaic on the north and an herbaceous community on the south bank (Vegetation Map EB-13, milepost 44). Cultivated fields occupy the riparian zone south of the river and a road and cropland bound the river on the north. Additional bottomland crossed by the pipeline has been designated as Riparian vegetation north of the river. The distinction between Cropland and Riparian is somewhat arbitrary in this area. While much of the area is not cultivated, it is certainly grazed more intensively than the open rangelands.

Most of the riparian habitat in the Bighorn River valley has been converted to cropland. Except for a narrow border of shrubs, cultivated fields line the river's south bank at the crossing location. The north bank between the river and the railroad tracks is about 20 acres of shrub/herbaceous riparian habitat with small trees lining minor drainage channels associated with the railroad tracks. An adjustment of the route upstream or down would disturb less Riparian and more Cropland type, but would move the pipeline out of the existing corridor.

Two plants of special interest are known from the vicinity of the trunk pipeline route. They are: Porter's Sagebrush (<u>Artemisia porteri</u>) and the Owl Creek Miner's Candle (<u>Cryptantha subcapitata</u>).

<u>Porter's Sagebrush</u>. <u>Artemisia porteri</u> is a federal category 3C species and ranked G3S3 by the Heritage Program. The short, shrubby, perennial sagebrush is in the aster family (Asteraceae) and is similar in appearance to <u>A. pedatifida</u>, with which it sometimes occurs. In part, the species can be distinguished by <u>A. porteri</u>'s more robust habit including broader leaf blades. In contrast to <u>A. pedatifida</u>, many of <u>A. porteri</u>'s basal and cauline leaves are entire (Cronquist, 1951).

The plant is known from clay slopes and sparsely vegetated badlands in <u>Atriplex gardneri</u> (Desert Shrub) communities. It is often associated with ash derived from Tertiary volcanics. While there are several populations, all are within Known Geologic Structure (KGS) boundaries which have high potential for oil and gas development. The population closest to the Elk Basin Project is about one mile south of milepost 139 of the Elk Basin CO_2 Trunk Pipeline (Vegetation Map EB-32).

<u>Owl Creek Miner's Candle</u>. <u>Cryptantha subcapitata</u> is a federal category 2 species and is given the highest Heritage Program rank G1S1. The principal habitat of this herbaceous perennial of the borage family (Boraginaceae) is very rocky slopes of dolomite limestone. Populations are known from the vicinity of Boysen Dam, Arrowhead Ridge in the Owl Creek Mountains, Fort Washakie and Cedar Ridge, which is about 8.5 miles southwest of milepost 124 of the Elk Basin CO_2 Trunk Pipeline. At Cedar Ridge, the plant is found with Juniper (<u>Juniperus</u>

osteosperma) at 5,600 to 6,000 feet on north slopes and on the crest of the ridge.

Many-Stemmed Spiderflower. The U.S. Fish and Wildlife Service identified Cleome multicaulis, a federal category 2 and Heritage Program S1G3G4 species as potentially occurring in the project area. The Many-stemmed spiderflower, a member of the caper family (Capparaceae), was once known to occur as far south as northern Mexico. Today it is known only from the San Luis Valley of Colorado and from one population north of Pathfinder Reservoir in Natrona County, Wyoming. The habitat of the plant is reported for the synonymous taxon C. sonorae as "low subsaline grounds"; "alkaline sink, about 4,000 feet elevation" (Rocky Mountain Heritage Task Force, 1987).

While the only known Wyoming population of the spiderflower is more than 35 miles south of the Elk Basin CO_2 Trunk Pipeline, there have been no systematic surveys for this species. It could occur in moist alkali soils traversed by the pipeline.

2.3.3 Agriculture

Livestock grazing is the principal agricultural activity along most of the Elk Basin CO_2 Pipeline route. The pipeline would traverse 38 grazing allotments in five BLM Resource Areas (see Table 2-9). Cattle dominate most of the resource areas, although sheep are also found throughout the pipeline route. Licensed use ranges from 0.01 AUM per acre (100 acres per AUM) to 0.46 AUM per acre (about 2 acres per AUM), both extremes being found in the Platte River Resource Area. Licensed use of 0.06 - 0.15 AUM per acre (7 - 16 acres per AUM) is more typical of the pipeline route.

Wastewater discharged from the existing Elk Basin plant to Silver Tip Creek is currently used to water livestock in the area.

The majority of cropland along the Elk Basin CO_2 Pipeline is in the Shoshone River drainage (Vegetation Map EB-7, 9 and 10), the Greybull River valley (Vegetation Map EB-13, mileposts 42 to 47) and the Bighorn River valley (Vegetation Map EB-22, mileposts 85 to 87). Sugar beets, malt barley, alfalfa, beans, oats, wheat, corn, and other forage and seed crops are the principal irrigated crops. The main water diversions are used continuously from mid-April to mid-October to irrigate the area. Ditch riders, hired by the various water companies or irrigation districts, deliver water from these mains to numerous small ditches when requested by the farmers, usually with 24 to 48 hours notice.

Cropland traversed in the Shoshone drainage is irrigated as part of three irrigation units: the Garland and Willwood Divisions of the Bureau of Reclamation Shoshone Project and the Elk Water Users Association area. The Frannie Canal (milepost 12.7, Vegetation Map EB-7) forms the northern boundary of the Garland Division which includes farmland south to the Shoshone River. Lateral D of the Garland Division is crossed at milepost 17.4 and the Sidon Canal, just north of the Shoshone River is crossed at milepost 20.6. The Garland Division is operated by the Shoshone Irrigation District. The Shoshone River and the Elk Canal (also known as the Elk-Lovell), which is crossed at milepost 22 (Vegetation Map EB-10), form the boundaries of the Elk Water Users Association area. Within this area, the Penrose Drainage Ditch is crossed at milepost 21.1. The Elk Basin CO_2 Trunk Pipeline would cross the Willwood Division of the Shoshone Project, operated by the Willwood Irrigation District,

between the Elk Canal and the Willwood Canal Lateral (W-135) at milepost 26.4 (Bureau of Reclamation, 1972; Shoshone - Heart Mountain Irrigation District, 1988; Willwood Irrigation District, 1988; Elk Water Users Association, 1988). Several small ditches are traversed in each of these areas.

Several private water companies form the Greybull Valley Irrigation District which controls irrigation on the Greybull River in the vicinity of Burlington. The major diversions which would be crossed by the Elk Basin CO_2 Pipeline are the Bench Canal (Vegetation Map EB-12, milepost 42.4), Farmer's Canal (Vegetation Map EB-13, milepost 43.4) and the Bank Lateral (milepost 43.6). The Maller Ditch, Tatman Canal, St. Joe Canal and many smaller ditches would also be crossed one or more times (Hoyt, 1988).

Both the Bluff Canal Irrigation District and Upper Hanover Irrigation District operate along the Bighorn River near Neiber. The major diversions which would be crossed are the Upper Bluff and Bluff Canals north of the river at mileposts 85.5 and 85.8 (Vegetation Map EB-22) and the Upper Hanover Canal (milepost 87.4) south of the river (Cooper, 1988).

2.4 BEAVER CREEK CO_2 PROJECT

2.4.1 Soils

There are several general Fremont County soil types in the Beaver Creek Field or which would be traversed by the trunk pipeline. These are:

Map Symbol	General Soil Unit
BF12	Haplargid - Torriorthents: Dominately light-colored soils of basins, terraces and fans which are usually dry or may be moist in some parts during the summer. The soils are formed from residual materials;
BF8	Torriorthents - Haplargids - Rock outcrop: Dominately light-colored soils of basins, terraces and fans which are usually dry or may be moist in some parts during the summer. Soils are formed from residual materials; and
MF3	Haploborolls - Argiborolls - Rock outcrops: Dominately dark-colored soils of the mountains and mountain valleys that are usually moist in some parts during the summer. Soils are formed from residual materials.

Table 2-17 lists the soil units mapped in the Beaver Creek CO_2 Project vicinity. This table includes the potential productivity and potential vegetation type of the soils. Table 2-18 lists the soil series in the area and gives their taxonomic classification. Appendices B, C and D contain tables of engineering properties, physical and chemical properties and soil and water features of the project area soils.

Most of the soils which would be disturbed during pipeline construction have at least some limiting feature (Appendix A, Table A-3 and Soil Maps BC-1 through BC-10). Of the 43.9 miles of pipeline, only 2.4 miles have no limitations. About 14.5 miles have minor textural limitations, i.e., soils with one or more loamy sand horizon. An additional 5.9 miles are limited by more coarse soils, i.e., sandy or coarser soil and/or more than 35 percent fragments. The

Table 2-17. Beaver Creek CO2 Project Soil Units, Including Potential Production and Vegetation Type. (a)

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
Fe11	Ryan Park loamy fine sand, undulating	700-1,500	1,200	G, S/G
F2d11	Bosler-Ryan Park fine sandy loam, 1-8% (d)			
	45% Bosler	700-1,500	1,200	G, S/G
	30% Ryan Park	700-1,500	1,200	G, S/G
F3d11	Bosler-Rock River sandy loam, 1-8%			
	45% Bosler	700-1,500	1,200	G, S/G
	40% Rock River	700-1,500	1,200	G, S/G
F2n11	Clifsand-Persayo complex, hilly			
	45% Clifsand	100-300	200	G, S/G
	30% Persayo	125-350	50	DS
F2a32	Dahlquist-Rock River complex, 1-12%			
	55% Dahlquist	600-1,400	1,000	G, S/G
	25% Rock River	700-1,500	1,200	G, S/G
F2j72	Rallod-Rock outcrop-Seaverson complex, hilly	500-1,000	800	G, S/G
	45% Rallod			
	20% Rock Outcrop			
	20% Seaverson			
F90	Zeomont loamy sand, hilly			
F101	Badland-Seaverson-Blazon complex, steep	500-1,000	800	G, S/G
	45% Badland			
	20% Seaverson			
	20% Blazon			
F102	Badland-Birdsley complex, steep			
	50% Badland			
	30% Birdsley	100-300	200	DS
F105	Rock outcrop-Blazon complex, hilly	500-1,000	800	G, S/G
	50% Rock Outcrop			
	30% Blazon			
F107	Rock outcrop-Blackhall complex, hilly	700-1,200	900	S/G
	40% Rock Outcrop			
	40% Blackhall			
F201	Havre-Forelle-Glendive complex, 0-3%			
	45% Havre	1,200-2,200	1,800	S/G
	20% Forelle	600-1,400	1,100	S/G
	15% Glendive	1,200-2,200	1,800	S/G
F203	Venapass-Silas loam, 0-6%			
	55% Venapass	3,500-6,000	5,000	R
	30% Silas	1,200-2,200	1,800	SG
F205	Iceslew-Countryman complex, 0-3%	2,500-3,400	3,000	R
	55% Iceslew			
	30% Countryman			
F209	Havre-Absher-Forelle loam, 0-6%			
	40% Havre	1,200-2,200	1,800	S/G
	20% Absher	1,200-2,500	1,800	R, GW
	20% Forelle	600-1,400	1,100	S/G
F217	Sanbranch-Ryan Park Variant-Poposhia complex, 1-8%			
	50% Sanbranch	800-2,000	1,200	R
	15% Ryan Park Variant	300-700	500	G, S/G
	15% Poposhia	300-700	500	G, S/G

Table 2-17. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
F227	Brownsto very bouldery-Decross Variant-Brownsto complex, 1-10%			
	55% Brownsto, very bouldery	400-900	650	S/G, CW
	15% Decross Variant	1,200-2,400	1,800	G
	15% Brownsto	350-700	500	S/G
F267	Almy-Monbutte-Rallod complex, 1-10%			
	40% Almy	600-1,400	1,100	S/G
	25% Monbutte	500-1,300	1,100	S/G
	15% Rallod	700-1,200	900	S/G
F270	Poposhia-Blazon-Carmody complex, hilly			
	35% Poposhia	600-1,400	1,100	S/G
	30% Blazon	500-1,100	800	G
	15% Carmody	700-1,500	1,200	S/G
F272	Blackhall-Carmody association, hilly			
	45% Blackhall	700-1,200	900	S/G
	35% Carmody	700-1,500	1,200	G, S/G
F277	Diamondville-Forelle association, rolling	600-1,400	1,100	S/G
	50% Diamondville			
	30% Forelle			
F291	Cushool-Rock River association, 1-15%	700-1,500	1,200	G, S/G
	55% Cushool			
	35% Rock River			
F293	Cragosen-Rock outcrop-Carmody complex, hilly			
	45% Cragosen	700-1,200	900	S/G
	25% Rock Outcrop			
	15% Carmody	700-1,500	1,200	G, S/G
F294	Forelle-Poposhia association, 2-12%			
	45% Forelle	600-1,400	1,000	S/G
	40% Poposhia	500-1,300	1000	S/G
F298	Blazon-Rock outcrop-Carmody complex, hilly			
	50% Blazon	500-1,000	800	G, S/G
	20% Rock Outcrop			
	15% Carmody	700-1,500	1,200	G, S/G
F309	Havre-Havre Variant-Elkol complex 0-3%			
	15% Havre	1,200-2,200	1,800	S/G
	15% Havre Variant	2,500-3,400	3,000	R
	15% Elkol	1,200-2,500	1,800	R, GW
F311	Ryan Park-Carmody association, 1-15%	700-1,500	1,200	G, S/G
	50% Ryan Park			
	35% Carmody			
F340	Tisworth-Ryan Park-Countryman complex, gently undulating			
	40% Tisworth	700-1,500	1,200	G, S/G
	25% Ryan Park	700-1,500	1,200	G, S/G
	15% Countryman	2,500-3,400	3,000	R
F372	Cragosen-Carmody-Blazon complex, hilly			
	50% Cragosen	700-1,200	900	S/G
	20% Carmody	700-1,500	1,200	G, S/G
	15% Blazon	500-1,000	800	G
F393	Blackhall-Rock outcrop complex, steep			
	Blackhall	700-1,200	900	S/G
	Rock Outcrop			

Table 2-17. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
F409	Absher-Elkol complex, 0-4%	1,200-2,500	1,800	GW
	55% Absher			
	30% Elkol			
F469	Absher-Poposhia-Sinkson complex, 1-10%			
	25% Absher	275-650	450	DS
	25% Poposhia	500-1,100	800	S/G
	25% Sinkson	500-1,100	800	S/G
F493	Cragosen-Bosler-Cushool association, rolling			
	35% Cragosen	700-1,200	900	S/G
	30% Bosler	700-1,500	1,200	G, S/G
	20% Cushool	700-1,500	1,200	G, S/G
F672	Bluerim-Onason complex, hilly			
	55% Bluerim	700-1,500	1,200	G, S/G
	30% Onason	700-1,200	900	G, S/G
F700 70	Burnette loam, 3-10%	1,100-1,600	1,350	G, S/G
F995, 584	Ryark sandy loam, 1-6%	700-1,500	1,200	G, S/G
FMS	Dumps, mine			

a = Source: Data from Fremont County, Eastern Part Survey, draft.
b = Range = Unfavorable years to favorable years; Normal = median years.
c = Based on soil unit description and/or range site designation and description.
S/G = Sagebrush/Grassland; DS = Desert Shrub; G = Grassland;
CW = Coniferous Woodland; R = Riparian; GW = Greasewood subtype of Riparian;
d = % = percent slope.

Table 2-18. Taxonomic Classification of Beaver Creek CO2 Project Soils. (a)

Series	Taxonomic Classification
Absher	Fine, montmorillonitic Borrolic Natrargids
Almy	Fine-loamy, mixed Borollic Haplargids
Birdsley	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Blackhall	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Blazon	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Bluerim	Fine-loamy, mixed Borollic Haplargids
Bosler	Fine-loamy over sandy or sandy-skeletal, mixed Borollic Haplargids
Brownsto	Loamy-skeletal, mixed Borollic Calciorthids
Burnette	Fine, montmorillonitic Argic Pachic Cryoborolls
Carmody	Coarse-loamy, mixed (calcareous), frigid Ustic Torriorthents
Cliffsand	Loamy-skeletal, mixed, mesic Typic Calciorthids
Cragosen	Loamy-skeletal, mixed (calcareous), frigid, shallow Ustic Torriorthents
Cushool	Fine-loamy, mixed Borollic Haplargids
Dahlquist	Loamy-skeletal, mixed Borollic Haplargids
Decross Variant	Fine-loamy, mixed Aridic Haploborolls
Elkol	Fine, montmorillonitic (calcareous), frigid Ustertic Torriorthents
Forelle	Fine-loamy, mixed Borollic Haplargid
Glendive	Coarse-loamy, mixed (calcareous), frigid Ustic Torrifluvents
Havre	Fine-loamy, mixed (calcareous), frigid Ustic Torrifluvents
Havre Variant	Fine-loamy, mixed (calcareous), frigid Aquic Ustifluvents
Monbutte	Fine, mixed Borollic Natrargids
Onason	Loamy, mixed, nonacid, frigid, shallow Ustic Torriorthents
Persayo	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthent
Poposhia	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents
Rallod	Clayey, montmorillonitic, shallow Borollic Natrargids
Rock River	Fine-loamy, mixed Borollic Haplargids
Ryan Park	Coarse-loamy, mixed Borollic Haplargids
Ryan Park Variant	Coarse-loamy, mixed Borollic Haplargids
Sandbranch	Fine-loamy, mixed, frigid Typic Natrargids
Seaverson	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Silas	Fine-loamy, mixed Cumulic Cryoborolls
Sinkson	Fine-loamy, mixed (calcareous), frigid Ustic Torriorthents
Venapass	Coarse-loamy, mixed Cumulic Cryaquolls
Zeomont	Mixed, frigid Ustic Torripsamments

a = Source: Soil Conservation Service series descriptions (Form 5).

remaining soils have depth and/or permeability problems. About 1.9 miles have only low permeability, 8.5 miles are shallow and 10.7 miles are both shallow and have low permeability.

In addition to small areas of steep slopes (small hills or minor incised ephemeral drainages), about 2.7 miles of steep slope areas along the Beaver Creek Trunk Pipeline were identified and are listed in Appendix A, Table A-9. In addition to having steep slopes, the Beaver Divide area (about milepost 12, Soils Map BC-4) is identified by Case et al. (1984) as a landslide area.

2.4.2 Vegetation

Vegetation varies in the study area with soils, precipitation, topography and land management practices. The Beaver Creek CO_2 Project lies within the High Plains Southeast 10- to 14-inch and Foothills and Mountains Southeast 15- to 19-inch precipitation zones (Soil Conservation Service, 1970). There are nine vegetation or land cover types mapped in the project area. They are: Sagebrush/Grassland, Desert Shrub, Grassland, Coniferous Woodland, Mixed Shrub, Riparian, Cropland, Barren/Badlands and Disturbed areas (Vegetation Maps BC-1 through BC-10). Affinis (1986a) provides more detailed, site-specific descriptions of vegetation types in the Beaver Creek Field. These descriptions were prepared from a field survey of the area.

Table 2-19 indicates by milepost the vegetation types which would be disturbed by pipeline and plant construction. Approximately 44 miles of trunk pipeline and recycle plant facilities will disturb about 445 acres. Sagebrush/Grassland dominates the area, accounting for over 68 percent of the disturbed vegetation. Grassland is also well represented south of the Sweetwater River but accounts for only 14 percent of all disturbed vegetation. Riparian communities are well developed along the perennial streams of the area including the Sweetwater River, Crooks Creek and Beaver Creek. Other riparian communities include Ice Slough and several small unnamed playas in the vicinity of milepost 30. Desert Shrub, Barren/Badlands and Cropland will not be directly affected by construction.

Three plants of special interest are known from the vicinity of the trunk pipeline route. They are: Porter's Sagebrush (*Artemisia porteri*), Meadow pussytoes (*Antennaria arcuata*) and the Rocky Mountain twinpod (*Physaria saximontana* var. *saximontana*).

Porter's Sagebrush. *Artemisia porteri* is a federal category 3C species and ranked G3S3 by the Heritage Program. The short, shrubby, perennial sagebrush is in the aster family (Asteraceae) and is similar in appearance to *A. pedatifida*, with which it sometimes occurs. In part, the species can be distinguished by *A. porteri*'s more robust habit including broader leaf blades. In contrast to *A. pedatifida*, many of *A. porteri*'s basal and cauline leaves are entire (Cronquist, 1951). Several populations of Porter's sagebrush are known near the Beaver Creek CO_2 Trunk Pipeline in the vicinity of Sand Draw Oil Field (mileposts 7 - 12) (Vegetation Maps BC-3 and BC-4). One population appears to be on the proposed Beaver Creek Pipeline right-of-way at milepost 12.

Meadow Pussytoes. *Antennaria arcuata* is a federal category 2 and Heritage Program G2S2 species. This small perennial herb of the sunflower family (Asteraceae) is distinguished from other local pussytoes by its arching white-woolly stolons and few basal leaves (Cronquist, 1950; Dorn, 1979). This species

Table 2-19. Vegetation Disturbed During Construction of the Beaver Creek CO2 Project. (a)

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
Field Facilities (b)		254.8	Undetermined	
Recycle Plant		40.0	Sagebrush/Grassland	
Meter Station		0.2	Sagebrush/Grassland	
		N.D.	Disturbed	
0 - .5	0.5	4.6	Sagebrush/Grassland	
.5 - .6	0.1	0.9	Riparian	Sand Draw; sandy creek bottom with big sagebrush in meanders along banks
.6 - 1.2	0.6	5.5	Sagebrush/Grassland	
1.2 - 2.0	0.8	7.3	Mixed Shrub	
2.0 - 2.3	0.3	2.7	Sagebrush/Grassland	
2.3 - 2.4	0.1	0.9	Mixed Shrub	
2.4 - 11.8	8.7	79.2	Sagebrush/Grassland	
7.2 - 7.6 (c)	0.4	3.6	Riparian	Ephemeral drainage; dense to moderately dense sagebrush and greasewood
9.2 - 10.4	0.3	2.7	Riparian	Ephemeral drainage; dense sagebrush and greasewood within the Sand Draw oil field Pipeline crosses at 10.3
Road crossing bore pits		1.1	Sagebrush/Grassland	
11.8 - 12.9	1.1	10.0	Mixed Shrub	Steep, dissected terrain, includes Skunkbush sumac and Porter's sagebrush
12.9 - 13.3	0.4	3.6	Coniferous Woodland	Beaver Divide; steep with scattered conifers
13.3 - 24.3	10.4	94.6	Sagebrush/Grassland	
16.0	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush and greasewood
20.7	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush and greasewood
19.4	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush with greasewood; narrow rocky, steep channel bank
22.0	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush with greasewood; narrow rocky, steep channel bank
22.2	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush with greasewood; rocky channel bank; particularly steep on northwest side.
22.5	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush and greasewood; hilly terrain
24.3 - 24.6	0.3	2.7	Riparian	Dense sagebrush and greasewood Pipeline route approaches riparian zone which is adjacent to a hill to the east and another pipeline to the west; Avoid riparian zone staying close to existing pipeline and avoid blading;
24.6 - 24.7	0.1	0.9	Sagebrush/Grassland	
24.7 - 25.0	0.3	2.7	Riparian	Sweetwater River; mosaic of tree, shrub and herbaceous communities; Cottonwoods, willow, etc. line banks; flat areas between meaders are herbaceous, some grazed or cut for hay
River crossing staging area		2.3	Riparian	
25.0 - 28.9	3.8	34.6	Sagebrush/Grassland	
26.5	0.1	0.9	Riparian	Ephemeral drainage; dense sagebrush and greasewood
28.9 - 29.0	0.1	0.9	Riparian	Herbaceous and shrub mosaic at northeast end of pond
29.0 - 29.4	0.4	3.6	Sagebrush/Grassland	
29.4 - 29.8	0.4	3.6	Riparian	Ice Slough; mosaic of herbaceous, shrub and tree dominated communities Pipeline crosses mostly herbaceous; Baltic rush and Alkali cordgrass
29.8 - 35.4	4.6	41.9	Grassland	
30.3 - 30.5	0.2	1.8	Riparian	Mosaic of dense shrub and herbaceous communities; sagebrush and greasewood sedges, Baltic rush and Alkali cordgrass
31.3 - 31.6	0.3	2.7	Riparian	Playa lake with barrens, herbaceous, high density sagebrush and greasewood and willow Most disturbance in herbaceous: Baltic rush, Flatsedge and Thickspike wheatgrass
33.3 - 33.6	0.3	2.7	Riparian	Ephemeral drainage; dense sagebrush
34.3	0.1	0.9	Riparian	Sand bottom creek; dense shrubs on banks
35.4	0.1	0.9	Riparian	O'Brien Creek; dense shrubs, mostly sagebrush
Road crossing bore pits		1.1	Grassland	

Table 2-19. Continued.

Location by Milepost	Disturbance Miles	Acres	Vegetation Type	Comments
35.4 - 39.0	2.3	20.9	Grassland	
	1.2	10.9	Sagebrush/Grassland	
36.8	0.1	0.9	Riparian	Ephemeral drainage; mostly dense sagebrush
39.0 - 39.9	0.9	8.2	Riparian	Pipeline adjacect to Riparian and cultivated fields; mosaic of trees and willows on creek with wet meadows; pipeline construction can avoid by limiting blading
39.9 - 41.0	1.1	10.0	Riparian	Crooks Creek; mosaic of willow and herbaceous
41.0 - 41.1	0.1	0.9	Riparian	Crooks Creek; mosaic of willow and herbaceous
41.1 - 41.9	0.8	7.3	Sagebrush/Grassland	
41.9 - 42.0	0.1	0.9	Riparian	Crooks Creek; mosaic of willow, dense sagebrush and greasewood and herbs including sedges, rushes and grasses
42.0 - 43.9	1.9	17.3	Sagebrush/Grassland	
Origin station		0.1	Sagebrush/Grassland	
Wellfield Total		254.8	Undetermined	
Pipeline Totals	28.7	303.0	Sagebrush/Grassland (d)	
	6.9	63.9	Grassland (e)	
	5.9	56.0	Riparian (f)	
	2.0	18.2	Mixed Shrub	
	0.4	3.6	Coniferous Woodland	
		N.O.	Disturbed	
		0.2	Undetermined (g)	
Total Disturbance	43.9	699.7		

a = Source: Mileage derived from Vegetation Maps BC-1 through BC-10.
Minimum mileage lenth recorded is 0.1 miles, therefore the width of narrow ephemeral drainages has been exaggerated.
b = Estimated disturbance for replacement of production and injection pipelines; location of pipelines is not yet determined.
c = Indented mileages indicate riparian areas, usually ephemeral drainages, within the range of another vegetation type.
d = Acreage includes recycle plant, meter station, origin station and road crossing pits.
e = Acreage includes road crossing pits.
f = Acreage includes river crossing staging area.
g = Includes undetermined locations of block valves.

grows in moist meadows and drainageways, often on hummocks of sedges and rushes (Riparian vegetation type) in Sagebrush/Grassland valley bottoms. It is currently known from a tributary to the East Fork of Long Creek, about 10 miles east of milepost 15.

Rocky Mountain Twinpod. Physaria saximontana var. saximontana does not have a federal status but is ranked G3T2S2 by the Heritage Program. Rollins (1984) described this small, herbaceous perennial in the mustard family (Brassicaceae) in 1984 after observing a number of populations of Physaria which did not fit with the features of P. didymocarpa. The most significant distinguishing characteristic is the silique, which in P. saximontana, has no sinus at its base. In addition, its stellate trichomes are not uniform over the entire plant as they are in many species of the genus. The variety is distinguished by its entire radical leaves and relatively short styles.

The habitat of the Rocky Mountain twinpod includes north facing limestone slopes. Populations are known from several locations in Fremont County. The site closest to the Beaver Creek CO_2 Trunk Pipeline is about 7 miles southwest of milepost 15 (Vegetation Map BC-4).

2.4.3 Agriculture

Livestock grazing is the principal agricultural activity in the Beaver Creek CO_2 Project area. The trunk pipeline would traverse 12 grazing allotments in the Lander Resource Area and the Beaver Creek Field is divided between two additional allotments (see Table 2-9). All of these allotments are either category I or M. Licensed use in allotments along the pipeline ranges from an average of 0.03 AUM per acre (about 33 acres per AUM) to 0.16 AUM per acre (about 6 acres per AUM). About two-thirds of the licensed AUMs are allocated to cattle which are generally run as cow-calf operations. Cattle use Beaver Creek as a water source within the field.

Small areas of cropland (mapped as the Riparian vegetation type) are scattered along perennial creeks in the area. The largest private holdings used for hay production are along the Sweetwater River (Vegetation Map BC 6, milepost 25) and Crooks Creek (Vegetation Map BC-9, milepost 39). There is no prime farmland in Fremont County (Soil Conservation Service, 1983a).

2.5 LITTLE BUFFALO BASIN CO_2 PROJECT

2.5.1 Soils

There are several general types of soils in the Little Buffalo Basin Field and along the spur pipeline, including:

Map Symbol	General Soil Unit
Hot Springs and Park Counties:	
U1	Typic Torriorthents, mesic shallow - Rock outcrop - Typic Torrifluvents, mesic: Shallow and very deep, well drained, brownish loamy soils formed in material weathered from interbedded sandstone and shale;

U3 Borollic Haplargids - Rock outcrop - Ustic Torriorthents, frigid: Very deep and shallow, well drained, brownish, sloping clayey soils formed in alluvium and material weathered from shale. Bedrocks are shale and sandstone;

U6 Ustic Torriorthents, mesic - Rock outcrop: Very deep and shallow, well drained, brownish loamy soils formed in alluvium and material weathered from interbedded sandstone and shale; and

V2 Ustic Torriorthents, frigid, mesic: Very deep, well drained, reddish and brownish loamy soils formed in alluvium.

Washakie County:

1 Typic Torrifluvents, mesic: Deep, well drained, nearly level to moderately sloping soils on alluvial fans, terraces, and floodplains and in valleys;

3 Typic Torriorthents, mesic - Rock outcrop - Typic Torrifluvents, mesic: Shallow and deep, well drained, gently sloping to steep soils, and Rock outcrop on hills, ridges, escarpments, fans and terraces; and

5 Typic Haplargids, mesic - Typic Natrargids, mesic: Deep and shallow, well drained, gently sloping to steep soils on alluvial fans and uplands.

Table 2-20 lists the soil units mapped in the Little Buffalo Basin CO_2 Project vicinity. This table includes the potential productivity and potential vegetation type of the soils. Table 2-21 lists the soil series in the area and gives their taxonomic classification. Appendices B, C and D contain tables of engineering properties, physical and chemical properties and soil and water features of the project area soils.

Over half (62 percent) of the soils which would be disturbed during pipeline construction have at least some limiting feature (Appendix A, Tables A-4 and A-8 and Soil Maps LBB1a through LBB-10). Of the 35.5 miles of pipeline, 13.4 miles have no limitations. About 2.2 miles have only textural limitations, including soils with one or more loamy sand horizon and very coarse soils, i.e., sandy or coarser soil with more than 35 percent coarse fragments. The remaining soils have depth and/or permeability problems. About 7 miles have only low permeability, 3.5 miles are shallow and 5.8 miles are both shallow and have low permeability. The latter includes about 0.5 mile with an additional salinity problem. The remaining three miles have low permeability and high salinity, but are not rated as shallow. Appendix A, Table A-9 lists about 2.6 miles of steep slope areas along the spur pipeline route.

2.5.2 Vegetation

Vegetation varies in the study area with soils, precipitation modified by elevation, topography and land management practices. The Little Buffalo Basin CO_2 Project area lies within the Big Horn Basin 5- to 9-inch and Foothills and Basins East 10- to 14-inch precipitation zones (Soil Conservation Service, 1970). Construction of the Little Buffalo Basin Project would affect all seven of the vegetation or land cover types mapped for the area. They are: Sagebrush/Grassland, Desert Shrub, Coniferous Woodland, Riparian, Cropland,

Table 2-20. Little Buffalo Basin CO2 Project Soils, Including Potential Production and Vegetation Types. (a)

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
Washakie County				
4	Apron-Worland sandy loam, 1-12% (d)	225-600	375	S/G
7	Baroid sandy loam	1,400-2,400	1,800	R, C
14	Clifterson-Persayo association	100-300	200	S/G
		200-550	350	DS
		225-600	350	S/G
16	Dobent loam	1,800-2,600	2,400	R, C
18	Finnerty sandy clay, wet, 0-3%			
23	Fruita-Neiber association	225-600	365	S/G
		200-550	350	DS
26	Glenton-Baroid sandy loam, wet	1,800-2,600	2,400	R, C
30	Greybull-Persayo association	200-550	350	DS
31	Griffy sandy loam, 1-10%	225-600	375	S/G
40	Lostwells clay loam, 0-3%	225-600	365	S/G, C
41	Lostwells clay loam, 3-6%	225-600	365	S/G
42	Lostwells-Youngston complex, 1-10%	225-600	365	S/G
		200-550	350	DS
43	Lostwells-Youngston complex, wet, 0-6%	1,800-2,600	2,400	R, C
		225-600	365	S/G, C
46	Muff-Neiber fine sandy loam, 3-30%	200-550	350	DS
		225-600	375	S/G
56	Persayo-Muff-Rock outcrop association	200-550	350	DS
57	Persayo-Rock outcrop association	85-300	175	DS
60	Riverwash			
61	Rock outcrop-Persayo complex, 15-70%	85-300	175	DS
67	Stutzman sandy clay loam, wet, 0-3%	1,800-2,600	2,400	R, C
71	Uffens-Rairdent complex, 1-10%	200-550	350	DS
		225-600	365	S/G
		225-600	375	S/G
73	Wallson loamy fine sand, 1-10%	225-600	375	S/G
74	Wallson sandy loam, 3-6%	225-600	375	S/G, C
81	Youngston clay loam, mod wet, 0-3%	1,400-2,400	1,800	R, C
82	Youngston sandy clay loam, 0-3%	200-550	350	DS, C
84	Youngston-Uffens-Lostwells complex, 1-10%	200-550	350	DS
Grass Creek Area, Hot Springs and Park Counties				
HS68	Cadoma-Epsie complex, 3-45%			
	50% Cadoma	275-650	450	DS
	25% Epsie	275-650	450	DS
HS71	Cadoma-Shingle complex			
	60% Cadoma Silty clay loam	275-650	450	DS
	25% Shingle loam	350-700		S/G, G
HS, P72	Absted-Arvada complex 0-10%			
	40% Absted	500-1,100		G
	35% Arvada	275-650		DS
HS75	Arvada-Kim, alkali complex 0-10%			
	40% Arvada fine sandy loam	275-650		DS
	35% Kim alkali loam	600-1,200		R

Table 2-20. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
HS102	Rock Outcrop, very steep 30-100%			
HS, P110	Shingle-Tassel complex 3-45%			
	50% Shingle loam	350-700		G, S/G, C
	35% Tassel sandy loam	350-700		G, S/G, C
HS111	Rock Outcrop-Shingle-Tassel complex			
	30% Rock Outcrop			
	25% Shingle loam	350-700		G, S/G, C
	25% Tassel sandy loam	350-700		G, S/G, C
HS190	Epsie-Shingle complex, 6-45%			
	45% Epsie	275-650		DS
	30% Shingle	350-700		G, S/G, C
HS243	Kim alkali-Kim loam 0-6%			
	50% Kim alkali loam	600-1,200		R
	30% Kim loam			
HS244	Kim alkali loam 0-6%	600-1,200		R
HS246	Orella-Epsie-Rock Outcrop complex 0-45%			
	45% Orella Silty clay	275-650		DS
	25% Epsie clay	275-650		DS
	20% Rock Outcrop			
HS, P247	Torriorthents, severly eroded 0-15			
HS322	Nihill-Shingle gravelly loam 0-45%			
	45% Nihill gravelly loam	100-450		G
	30% Shingle gravelly loam	350-700		G
HS324	Larimer-Nihill complex 3-45%			
	40% Larimer loam	500-1,100		G
	40% Nihill gravelly loam	100-450		G
HS325	Larimer-Stoneham-Nihill complex 3-30%			S/G
	30% Larimer loam	500-1,100		G
	30% Stoneham loam	500-1,100		G
	20% Nihill gravelly loam	100-450		G
HS345	Vona-Otero sandy loam 3-15%	500-1,100		G
	45% Vona sandy loam			
	35% Otero sandy loam			
HS, P360	Stoneham-Kim association 0-8%			
	50% Stoneham loam	500-1,100		G
	30% Kim loam	500-1,100		G
HS372	Tassel-Nelson sandy loam 2-45%			
	50% Tassel sandy loam	350-700		G, S/G
	25% Nelson sandy loam	500-1,100		G, S/G
HS375	Bowbac-Olney-Arvada complex 0-15%			
	30% Bowbac fine sandy loam	500-1,100		G
	25% Olney sandy loam	500-1,100		G
	25% Arvada loam	275-650		DS
HS382	Rock Outcrop-Tassel complex 3-60%			
	40% Rock Outcrop			G, S/G, CW
	40% Tassel sandy loam	350-700		G
HS383	Rock Outcrop-Tassel-Nelson complex			
	30% Rock Outcrop			
	20% Tassel sandy loam	350-700		G, S/G
	20% Nelson sandy loam	500-1,100		G, S/G

Table 2-20. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
HS, P393	Olney-Bowbac complex 3-15%			
	45% Olney sandy loam	500-1,100		G, S/G
	35% Bowbac fine sandy loam	500-1,100		G, S/G
HS, P398	Tassel-Bowbac-Terry complex 3-30%			
	30% Tassel sandy loam	350-700		G, S/G
	25% Bowbac fine sandy loam	500-1,100		G, S/G
	25% Terry fine sandy loam	500-1,100		G, S/G
HS410	Bondman-Worfka-Worf complex 0-15%			
	30% Bondman fine sandy loam	350-700		G, S/G
	25% Worfka loam	350-700		G, S/G
	25% Worf loam	350-700		G, S/G
HS411	Bondman-Rock Outcrop-Worf complex 3-45%			S/G
	35% Bondman fine sandy loam	350-700		G
	25% Rock Outcrop			
	20% Worf loam	350-700		G, S/G
HS426	Larim-Larimer complex 3-15%			
	50% Larim gravelly loam	100-450		G
	40% Larimer loam	500-1,100		G
HS447	Travessilla stony loam, thick solum 3-45%			
HS, P448	Torrifluvents, saline 0-6%			R, DS, C
HS, P490	Shingle-Thedalund loam 0-45%			
	40% Shingle loam	350-700		S/G, G
	35% Thedalund loam	500-1,100		S/G, G
HS601	Youngston-Uffens-Glenton complex 0-6%			
	35% Youngston loam	225-600		S/G
	30% Uffens very fine sandy loam	200-550		DS
	20% Glenton loam	225-600		S/G
HS604	Effinton-Effington Variant complex 0-10%			
	50% Effington Silty loam	200-550	350	DS
	30% Effington Variant Silty clay loam	200-550	350	DS
HS645	Mudray-Persayo-Effington Variant 3-30%			
	40% Mudray very fine sandy loam	200-550	350	DS
	25% Persayo clay loam	85-250	150	DS
	15% Effington Variant Silty clay loam	200-550	350	DS
HS671	Rock Outcrop-Persayo complex 3-60%			
	50% Rock Outcrop			
	35% Persayo	85-250	150	DS
HS, P700	Stoneham-Cushman loam 3-15%			
	50% Stoneham loam	500-1,100	800	G, S/G
	30% Cushman loam	500-1,100	800	G, S/G
HS, P702	Absted-Fort Collins loam 3-15%			
	45% Absted loam	500-1,100	800	G, S/G
	35% Fort Collins loam	500-1,100	800	G, S/G
HS703	Fort Collins-Cushman loam 3-15%			
	50% Fort Collins loam	500-1,100	800	G, S/G
	30% Cushman loam	500-1,100	800	G, S/G
HS705	Kim-Thedalund loam 3-15%			
	50% Kim loam	500-1,100	800	G, S/G
	30% Thedalund loam	500-1,100	800	G, S/G

Table 2-20. Continued.

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
HS709	Renohill-Cadoma-Worfka complex 0-20%			
	40% Renohill clay loam	500-1,100	800	DS, G
	25% Cadoma Silty clay loam	275-650	450	DS
	20% Worfka loam	350-700	500	S/G, G
HS, P720	Blazon-Rock Outcrop complex 3-60%			
	45% Blazon loam	350-700	500	S/G, G
	30% Rock Outcrop			
HS722	Blazon loam 3-45%	350-700	500	S/G, G
HS749	Renohill-Worfka complex 0-20%			
	45% Renohill clay loam	500-1,100	800	DS, G
	35% Worfka loam	350-700	500	S/G, G
HS751	Worfka-Shingle-Rock Outcrop complex 3-45%			
	45% Worfka loam	350-700	500	S/G, G
	20% Shingle loam	350-700	500	S/G, G
	15% Rock Outcrop			

a = Source: Washakie County Soil Survey and Grass Creek Area Survey in Hot Springs and Park Counties.
b = Range = Unfavorable years to favorable years; Normal = median years.
c = Based on soil unit description and/or range site designation and description.
S/G = Sagebrush/Grassland; DS = Desert Shrub; G = Grassland;
CW = Coniferous Woodland; C = Cropland; R = Riparian; GW = Greasewood subtype of Riparian;
MX = Mixed Shrub.
d = % = percent slope.

Table 2-21. Taxonomic Classification of Buffalo Basin CO2 Project Soils. (a)

Series	Taxonomic Classification
Absted	Fine, montmorillonitic, mesic Haplustollic Natrargids
Apron	Coarse-loamy, mixed (calcareous), mesic Typic Torriorthents
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Baroid	Sandy, mixed, mesic Typic Torrifluvents
Blazon	Loamy, mixed (calcareous), frigid, shallow Ustic Torriorthents
Bondman	Loamy, mixed, mesic Lithic Ustollic Haplargids
Bowbac	Fine-loamy, mixed, mesic Ustollic Haplargids
Cadoma	Fine, montmorillonitic, mesic Ustollic Camborthids
Clifterson	Loamy-skeletal, mixed (calcareous), mesic Typic Torriorthents
Cushman	Fine-loamy, mixed, mesic Ustollic Haplargids
Dobent	Fine-loamy, mixed (calcareous), mesic Typic Fluvaquents
Effington	Fine, montmorillonitic, mesic Typic Natrargids
Effington Variant	Fine, montmorillonitic, mesic Typic Natrargids
Epsie	Clayey, montmorillonitic (calcareous) mesic, shallow Ustic Torriorthen
Finnerty	Very-fine, montmorillonitic (calcareous), mesic Vertic Torriorthents
Forkwood	Fine-loamy, mixed, mesic Ustollic Haplargids
Fort Collins	Fine-loamy, mixed, mesic Ustollic Haplargids
Glenton	Coarse-loamy, mixed, (calcareous), mesic Typic Torrifluvents
Greybull	Fine-loamy, mixed (calcareous), mesic Typic Torriorthents
Griffy	Fine-loamy, mixed, mesic Typic Haplargids
Kim	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Kishona	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Larimer	Fine-loamy over sandy or sandy-skeletal, mixed, mesic Ustollic Haplarg
Lostwells	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents
Mudray	Clayey, montmorillonitic, mesic, shallow Tylpic Natrargids
Muff	Fine-loamy, mixed, mesic Typic Natrargids
Neiber	Fine-loamy, mixed, mesic Typic Haplargids
Nihill	Loamy-skeletal, mixed (Calcareous), mesic Ustic Torriorthents
Orella	Clayey, mixed (calcareous), mesic, shallow Ustic Torriorthents
Otero	Coarse-loamy, mixed (calcareous), mesic Ustic Torriorthents
Persayo	Loamy, mixed (calcareous), mesic, shallow Typic Torriorthents
Rairdent	Fine-loamy, mixed, mesic Cambic Gypsiorthids
Renohill	Fine, montmorillonitic, mesic Ustollic Haplargids
Riverwash	Calciorthids
Shingle	Loamy, mixed, (calcareous), mesic, shallow Ustic Torriorthents
Stoneham	Fine-loamy, mixed, mesic Ustollic Haplargids
Stutzman	Fine, montmorillonitic (calcareous), mesic Typic Torriorthents
Tassel	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Terry	Coarse-loamy, mixed, mesic Ustollic Haplargids
Thedalund	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Travessilla	Loamy, mixed (calcareous), mesic Lithic Ustic Torriorthents
Vona	Coarse-loamy, mixed, mesic Ustollic Haplargids
Wallson	Coarse-loamy, mixed, mesic Typic Haplargids
Worf	Loamy, mixed mesic, shallow Ustollic Haplargids
Worfka	Clayey, montmorillonitic, mesic, shallow Ustollic Haplargids
Worland	Coarse-loamy, mixed, (calcareous), mesic Typic Torriorthents
Youngston	Fine-loamy, mixed (calcareous), mesic Typic Torrifluvents

a = Source: Soil Conservation Service series descriptions (Form 5).

Barren/Badlands and Disturbed areas (Vegetation Maps LBB-1a through LBB-10). Table 2-22 indicates by milepost the vegetation types which would be disturbed by pipeline and plant construction. Approximately 35 miles of spur pipeline and recycle plant facilities will disturb about 367 acres. Sagebrush/Grassland and Desert Shrub are the dominant types in the area accounting for 56 and 24 percent of the disturbed area, respectively. About 1.3 miles (12 acres) of Coniferous Woodland, mostly occupying steep slopes or ridges, will be traversed.

Much of the Riparian vegetation crossed in the Gooseberry Creek drainage is the Greasewood subtype. The pipeline route does, however,intersect various riparian communities including tree/shrub and shrub/herb mosaics and a cattail marsh which has developed in a livestock reservoir. The pipeline will also traverse the Killifish Experimental Exclosure, a riparian demonstration area. In crossing this exclosure, the pipeline will be routed on a terrace above the riparian zone and fences will be maintained at all times to exclude cattle from the exclosure (see Wildlife Technical Report).

One plant of special interest, Evert's water parsnip, *Cymopterus evertii*, is found near the spur pipeline.

Evert's Water Parsnip. *Cymopterus everti* is a federal category 2 species and ranked G2S2 by the Heritage Program. This herbaceous perennial, in the carrot family (Apiaceae), is usually found on soils derived from volcanics but has also been located on rocky sandstone soils in association with Limber pine near Squaw Teats Road in Hot Springs County (Vegetation Map LBB-2). This site is less than 1.5 miles from milepost 5 of the Little Buffalo Basin CO_2 Spur Pipeline. The rocky area near milepost 8 of the pipeline appears to be suitable habitat for the species, but the proposed route avoids this outcrop.

2.5.3 Agriculture

Much of the Little Buffalo Basin CO_2 Spur Pipeline proposed route follows the agricultural valley of Gooseberry Creek (Vegetation Map LBB-3 through LBB-8). The spur pipeline crosses almost 3 miles of irrigated farmland and 2.3 miles of prime farmland, which is not all currently cultivated (see Table 2-22).

Several private irrigation ditches supply water to the area. Of these, five may be crossed one or more times by the Little Buffalo Basin CO_2 Spur Pipeline (Rhodes, 1988). These are:

- Holder Ditch (Vegetation Map LBB-7, milepost 26.5, 27.6);
- Homestead Ditch (Vegetation Map LBB-5, -7, milepost 25.0-.5, 23.3-24.1);
- Murphy Ditch (Vegetation Map LBB-5, milepost 18.5-22.0);
- Enlarged Quartz Ditch (Vegetation Map LBB-3, milepost 12.4, 14.5);
- Quartz Ditch (Vegetation Map LBB-3, milepost 14.4).

Produced water discharged from the Little Buffalo Basin Field currently enters Little Buffalo Creek, a tributary to Gooseberry Creek. Since natural streamflow available for irrigation does not always meet demand, this discharge of Buffalo Basin produced water is considered to be a benefit to agriculture (Roseberry, 1988; Rhodes, 1988).

Table 2-22. Vegetation Disturbed During Construction of the Little Buffalo Basin CO2 Project. (a)

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
Field Facilities (b)		819.0	Undetermined	
Recycle Plant		40.0	Sagebrush/Grassland	
Meter Station		0.2	Sagebrush/Grassland	
		N.D.	Disturbed	
0 - .3	0.3	2.7	Sagebrush/Grassland	
.3 - .4	0.1	0.9	Riparian	Ephemeral drainage
.4 - .7	0.3	2.7	Sagebrush/Grassland	
.7 - .8	0.1	0.9	Riparian	Little Buffalo Creek; mosaic of herbaceous and shrub communities; dominant shrubs include Big sagebrush, Rabbitbrush and Greasewood.
.8 - 1.3	0.5	4.6	Desert Shrub	
1.3 - 2.1	0.8	7.3	Riparian	Little Buffalo Creek; mosaic of herbaceous and shrub communities
2.1 - 2.4	0.3	2.7	Desert Shrub	
2.4 - 2.5	0.1	0.9	Riparian	Little Buffalo Creek; mosaic of herbaceous and shrub communities
2.5 - 2.9	0.4	3.6	Sagebrush/Grassland	
2.9 - 3.0	0.1	0.9	Riparian	Little Buffalo Creek; mosaic of herbaceous and shrub communities
3.0 - 3.5	0.5	4.6	Sagebrush/Grassland	
3.5 - 3.8	0.3	2.7	Coniferous Woodland	
3.8 - 4.2	0.4	3.6	Sagebrush/Grassland	
4.2 - 4.4	0.2	1.8	Coniferous Woodland	Moderately dense trees on steep slopes and ridge
4.4 - 4.7	0.3	2.7	Riparian	Little Buffalo Creek; mosaic of herbaceous and shrub communities.
4.7 - 7.1	2.1	19.1	Sagebrush/Grassland	
4.8 (c)	0.1	0.9	Riparian	Ephemeral drainage with defined channel but little change in upland shrub density.
5.7	0.1	0.9	Riparian	Ephemeral drainage; minor increase in shrub density
6.4	0.1	0.9	Riparian	Ephemeral drainage with defined channel but little change in upland shrub density.
Road crossing bore pits		1.1	Sagebrush/Grassland	
7.1 - 7.3	0.2	1.8	Cropland	
7.3 - 7.4	0.1	0.9	Sagebrush/Grasslnad	
7.4 - 7.5	0.1	0.9	Desert Shrub	
7.5 - 7.6	0.1	0.9	Riparian	Buffalo Creek; mostly herbaceous in bottom; dense shrubs on terraces
7.6 - 7.7	0.1	0.9	Desert Shrub	
7.7 - 7.8	0.1	0.9	Barren/Badlands	Sparse vegetation and steep slope
7.8 - 8.1	0.3	2.7	Sagebrush/Grassland	
8.1 - 8.2	0.1	0.9	Riparian	Ephemeral drainage; increased shrub density above creek with incised channel
8.2 - 8.3	0.1	0.9	Coniferous Woodland	Steep and rocky
8.3 - 8.8	0.4	3.6	Sagebrush/Grassland	
8.6	0.1	0.9	Riparian	Ephemeral drainage in Sagebrush/Grassland type; no apparent change in vegetation
8.8 - 9.1	0.3	2.7	Coniferous Woodlnad	Steep and rocky
9.1 - 9.8	0.5	4.6	Sagebrush/Grassland	
9.6	0.1	0.9	Coniferous Woodland	Low density trees at edge of community; steep terrain
9.8	0.1	0.9	Riparian	Ephemeral drainage; increase in shrub density; scattered trees in incised drainage
9.8 - 10.1	0.3	2.7	Coniferous Woodland	Steep terrain
10.1 - 11.8	1.7	15.5	Sagebrush/Grassland	
11.8 - 11.9	0.1	0.9	Riparian	Buffalo Creek; mosaic of herbaceous communities in low sites and shrubs on slightly higher terraces
11.9 - 12.3	0.4	3.6	Sagebrush/Grassland	
12.3 - 12.4	0.1	0.9	Cropland	
12.4 - 12.5	0.1	0.9	Riparian	Quartz Ditch and Gooseberry Creek; herbaceous with scattered shrubs
12.5 - 13.0	0.5	4.6	Desert Shrub	
13.0 - 13.7	0.7	6.4	Sagebrush/Grassland	
13.7 - 14.0	0.3	2.7	Desert Shrub	
14.0 - 14.2	0.2	1.8	Sagebrush/Grassland	
14.2 - 14.7	0.5	4.6	Cropland	Pipeline should be staked to avoid agricultural reservoir
14.7 - 14.8	0.1	0.9	Sagebrush/Grassland	

Table 2-22. Continued.

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
14.8 - 15.0	0.2	1.8	Riparian	Gooseberry Creek; herbaceous on lowest terraces with Big sagebrush and Greasewood shrublands in mosaic on upper terraces.
15.0 - 16.0	0.9	8.2	Sagebrush/Grassland	
15.4	0.1	0.9	Riparian	Ephemeral drainage; dense Greasewood
16.0 - 19.2	3.1	28.2	Desert Shrub	
18.8	0.1	0.9	Riparian	Murphy Draw; dense shrubs, mostly Greasewood
Road crossing bore pits		1.1	Desert Shrub	
19.2 - 19.5	0.3	2.7	Riparian	Cattail marsh with open water and willow; marsh community merges with shrub community and ephemeral drainage Pipeline could be routed either north or south of the pond; south route would intersect drier shrubby riparian and cropland North route would be in upland - necessary to avoid badlands at 19.8
19.5 - 19.9	0.4	3.6	Desert Shrub	
19.9 - 20.1	0.2	1.8	Riparian	Greasewood
20.1 - 22.4	2.3	20.9	Desert Shrub	Pipeline will cross Killifish riparian experimental exclosure but should be routed on bluff to avoid riparian zone; maintain fence at all times to exclude cattle; includes .2 miles of prime farmland soils.
22.4 - 23.5	1.1	10.0	Sagebrush/Grassland	
23.5 - 24.0	0.5	4.6	Riparian	Greasewood and Gooseberry Creek; herbaceous and shrub mosaic with few trees
24.0 - 25.5	1.5	13.7	Sagebrush/Grassland	Includes .1 mile of prime farmland soils.
25.5 - 27.7	2.1	19.1	Cropland	Includes 2.2 miles of prime farmland soils.
25.8 - 25.9	0.1	0.9	Riparian	Greasewood
27.7 - 30.3	2.6	23.7	Sagebrush/Grassland	Includes .1 mile of prime farmland soils.
Road crossing bore pits		1.1	Sagebrush/Grassland	
30.3 - 35.5	3.2	29.1	Sagebrush/Grassland and	
	1.9	16.8	Desert Shrub	
33.3	0.1	0.9	Riparian	Ephemeral drainage; slightly higher shrub density
Origin station		0.1	Desert Shrub	
Wellfield Total		819.0	Undetermined (b)	
Pipeline Totals	17.7	203.5	Sagebrush/Grassland (d)	
	9.5	87.2	Desert Shrub (e)	
	4.0	36.4	Riparian	
	2.9	26.4	Cropland	
	1.3	11.8	Coniferous Woodland	
	0.1	0.9	Barren/Badlands	
		N.D.	Disturbed	
		0.2	Undetermined (f)	
Total Disturbed	35.4	1185.5		

a = Source: Mileage derived from Vegetation Maps LB8-1a through LB8-10.
Minimum mileage length recorded is 0.1 miles, therefore the width of narrow ephemeral drainages has been exaggerated.
b = Estimated disturbance for replacement of production and injection pipelines; location of pipelines is not yet determined.
c = Indented mileages indicate locations of small changes in vegetation type within the range of another type.
d = Acreage includes recycle plant, meter station and road crossing bore pits.
e = Acreage includes origin station and road crossing bore pits.
f = Acreage includes block valves

Sugar beet hauling is an intensive activity with hauling to stockpiles and rehauling to the Worland processing facility beginning in early September and continuing to the end of the year. Gooseberry Creek sugar beets are stockpiled primarily at a station south of Worland (Thompson, 1988).

Livestock grazing is the other principal agricultural activity in the project area. Cattle dominate the industry on eight of the nine Grass Creek Resource Area allotments within the Beaver Creek Field and traversed by the Little Buffalo Basin CO_2 Spur Pipeline (see Table 2-9). Only allotment 0623 in the field is a C category allotment. Licensed use in allotments along the spur pipeline ranges from an average of 0.06 AUM per acre (about 17 acres per AUM) to 0.24 AUM per acre (about 4 acres per AUM). The Dickie Shearing Sheds just north of the pipeline route (Vegetation Map LBB-2, milepost 4.8) are temporarily inactive since the LU Sheep Company currently runs cattle.

2.6 SALT CREEK CO_2 PROJECT

2.6.1 Soils

There are two general Natrona County soils types in the Salt Creek Field and along the spur pipeline. They are:

Map Symbol	General Soil Unit
16	Typic Torriorthents, mesic - Ustollic Camborthids, mesic - Ustollic Natrargid, mesic: Shallow to deep, well drained, gently sloping to steep soils on ridges, hillslopes and fans. The soils are fine textured formed in residuum and slopewash alluvium from salt and alkali affected shale.
17	Ustollic Camborthids, mesic - Haplustollic Natrargid, mesic: Deep, well drained, gently sloping to moderately steep, soils of convex and concave slopes and fans. The soils are moderately coarse to moderately fine textured and strongly salt and alkali affected formed in alluvium, slopewash alluvium and residuum derived predominately from shale.

Table 2-23 lists the soil units mapped in the Salt Creek CO_2 Project vicinity. This table includes the potential productivity and vegetation type of the soils. Table 2-24 lists the soil series in the area and gives their taxonomic classification. Appendices B, C and D contain tables of engineering properties, physical and chemical properties and soil and water features of the project area soils.

Most of the soils which would be disturbed during pipeline construction have at least some limiting feature (Appendix A, Table A-6 and Soil Maps SC-1 through SC-5). Of the 9.2 miles of pipeline, only 0.8 mile has no limitations. The remaining soils have depth and/or permeability limitations. About 1.1 miles have only low permeability, 0.8 mile is shallow and 6.5 miles are both shallow and have low permeability. The project area is within the Salt Creek and Castle Creek Sensitive Drainages (BLM, 1984a).

Table 2-23. Salt Creek CO2 Project Soil Units, Including Potential Production and Vegetation Types. (a)

Map Symbol	Soil Name	Potential Production (pounds per acre) (b) Range	Normal	Potential Vegetation (c)
109	Amodac-Keyner complex, 2-12% (d)			
	Amodac	500-900	700	DS
	Keyner	500-900	700	S/G
112	Arvada-Absted-Slickspots complex, 0-6%			
	Arvada	350-700	500	DS
	Absted	600-1,400	1,100	S/G
125	Blackdraw-Lolite-Gullied land complex 3-20%			
	Blackdraw	300-650	500	DS
	Lolite	200-400	300	DS
132	Bowbac-Hiland fine sandy loam, 3-10%	600-1,400	1,100	S/G, C
134	Bowbac-Taluce-Terro complex 6-20%			
	Bowbac	600-1,400	1,100	S/G
	Taluce	700-1,200	900	G
	Terro	700-1,500	1,200	G
140	Cadoma-Renihill-Samday clay loam, 3-12%			
	Cadoma	350-700	500	G
	Renihill	500-1,300	1,000	S/G
	Samday	200-400	300	DS
150	Chipendale-Razsun clay loam, 3-15%			
	Chipendale	250-650	500	DS
	Razsun	750-1,800	1,300	S/G
167	Cushman-Forkwood association, rolling and undulating	600-1,400	1,100	S/G
195	Haverdad-Clarkelen complex, saline, 0-3%	1,200-2,500	1,800	R, GW
208	Keyner sandy clay loam, 3-10%	600-1,400	1,100	S/G
209	Keyner-Absted-Slickspots complex, 0-6%	600-1,400	1,100	S/G
210	Keyner-Hiland association, nearly level and undulating	600-1,400	1,100	S/G
214	Lolite-Rock outcrop complex 10-40%	200-400	300	DS
216	Lonebear clay loam, 3-12%	750-1,800	1,300	S/G
217	Lupinto-Alcova complex, 3-30%			
	Lupinto	700-1,200	900	S/G
	Alcova	600-1,400	1,100	S/G
275	Shingle-Taluce-Rock outcrop complex, 10-40%			
	Shingle	700-1,200	900	S/G
	Taluce	700-1,200	900	G
278	Silhouette-Petrie clay loam, 1-6%			
	Silhouette	500-1,300	1,000	S/G
	Petrie	350-700	500	DS
283	Theedle-Shingle-Kishona complex, 6-40%			
	Theedle	400-1,100	900	S/G
	Shingle	700-1,200	900	S/G
	Kishona	600-1,400	1,100	S/G

a = Source: Data from draft Natrona County Soil Survey.
b = Range = Unfavorable years to favorable years; Normal = median years.
c = Based on soil unit description and/or range site designation and description.
S/G = Sagebrush/Grassland, DS = Desert Shrub; G = Grassland;
CW = Coniferous Woodland; C = Cropland; R = Riparian; GW = Greasewood subtype of Riparian;
MX = Mixed Shrub.
d = % = Percent slope.

Table 2-24. Taxonomic Classification of Salt Creek Project Soil Series. (a)

Series	Taxonomic Classification
Absted	Fine, Montmorillonitic, mesic Haplustollic Natrargids
Alcova	Fine-loamy, mixed, Borollic Haplargids
Amodac	Fine-loamy, mixed, mesic Ustollic Camborthids
Arvada	Fine, montmorillonitic, mesic Ustollic Natrargids
Blackdraw	Fine, mixed, nonacid, mesic Ustic Torriorthents
Bowbac	Fine-loamy, mixed, mesic Ustollic Haplargids
Cadoma	Fine, montmorillonitic, mesic Ustollic Camborthids
Chipendale	Fine, mixed, mesic Cambic Gypsiorthids
Clarkelen	Coarse-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Cushman	Fine-loamy, mixed, mesic Ustollic Haplargids
Forkwood	Fine-loamy, mixed, mesic Ustollic Haplargids
Haverdad	Fine-loamy, mixed (calcareous), mesic Ustic Torrifluvents
Hiland	Fine-loamy, mixed, mesic Ustollic Haplargids
Keyner	Fine loamy, mixed, mesic Haplustollic Natrargids
Kishona	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents
Lolite	Clayey, mixed, nonacid, mesic, shallow Typic Torriorthents
Lonebear	Fine, mixed, mesic Cambic Gypsiorthids
Lupinto	Loamy-skeletal, mixed Borollic Haplargids
Petrie	Fine, montmorillonitic (calcareous), mesic Ustertic Torriorthents
Razsun	
Renohill	Fine, montmorillonitic, mesic Ustollic Haplargids
Samday	Clayey, montmorillonitic (calcareous) mesic, shallow Ustic Torriorthents
Shingle	Loamy, mixed, (calcareous), mesic, shallow Ustic Torriorthents
Taluce	Loamy, mixed (calcareous), mesic, shallow Ustic Torriorthents
Terro	Coarse-loamy, mixed, mesic Ustollic Haplargids
Theedle	Fine-loamy, mixed (calcareous), mesic Ustic Torriorthents

a = Source: Soil Conservation Service series descriptions (Form 5).

Most of the terrain crossed by the pipeline is gently rolling, but the route crosses several eroding ephemeral drainages. In addition to small areas of steep slopes (small hills or minor incised ephemeral drainages), two areas of steep slopes were identified on the Salt Creek Spur Pipeline route. The largest area is in Desert Shrub vegetation within the Salt Creek Field (milepost .5 - 1.2; Appendix A, Table A-9). The soil unit in this area is a rock outcrop complex of 10 to 40 percent slope.

2.6.3 Vegetation

Vegetation varies in the study area with soils, topography and land management practices. The Salt Creek CO_2 Project lies within the High Plains Southeast 10- to 14-inch precipitation zone (Soil Conservation Service, 1970). The project will affect the five vegetation types mapped in the vicinity. They are: Desert Shrub, Grassland, Sagebrush/Grassland, Riparian and Disturbed areas (Vegetation Maps SC-1 through SC-5). Table 2-25 indicates by milepost the vegetation types which would be disturbed by pipeline and plant construction. Approximately 9 miles of spur pipeline and recycle plant facilities will disturb about 126 acres. Desert Shrub is the dominant type accounting for over 60 percent of the disturbed area. A short grass Grassland is well represented in the area but only about 17 acres will be disturbed.

No plants of special interest have been identified in the Salt Creek Field or along the CO_2 Spur Pipeline.

2.6.4 Agriculture

There is no cropland in the Salt Creek CO_2 Project area. North of the Spur Pipeline, production of dry land wheat was attempted and abandoned years ago (Arnold, 1988). Agriculture is limited to livestock production with about two-thirds of the licensed AUMs allocated to sheep. The Salt Creek CO_2 Spur Pipeline passes through four grazing allotments and a stock driveway (see Table 2-9). All of these allotments are either category I or M. Licensed use in allotments along the pipeline ranges from an average of 0.02 AUM per acre (50 acres per AUM) to 0.18 AUM per acre (about 6 acres per AUM).

There are several stock watering reservoirs in the Salt Creek Field and along the spur pipeline route.

Livestock growers currently use the produced water discharge from the Salt Creek Field (Fifield, 1988).

Table 2-25. Vegetation Disturbed During Construction of the Salt Creek CO2 Project. (a)

Location by Milepost	Disturbance Miles	Disturbance Acres	Vegetation Type	Comments
Field Facilities (b)		1774.5	Undetermined	
Recycle Plant		40.0	Desert Shrub	
Meter Station		0.2	Desert Shrub	
		N.O.	Disturbed	
0 - 1.7	1.7	15.5	Oesert Shrub	
1.7 - 1.9	0.2	1.8	Sagebrush/Grassland	
1.9 - 2.0	0.1	0.9	Riparian	Bothwell Draw: ephemeral drainage with dense shrubs
2.0 - 3.3	1.3	11.8	Grassland	
3.3 - 3.4	0.1	0.9	Riparian	Ephemeral drainage; salt precipitate evident
3.4 - 3.8	0.3	2.7	Grassland	
3.6, 3.8 (c)	0.1	0.9	Riparian	Ephemeral drainages within the Grassland type; moderately shrubby
3.8 - 4.1	0.3	2.7	Sagebrush/Grassland	Bench eroded with many ephemeral channels; increase in sagebrush density in channels
4.1 - 4.6	0.3	2.7	Grassland	
4.3	0.1	0.9	Riparian	Ephemeral channel; incised with moderate density shrubs
4.6	0.1	0.9	Riparian	Ephemeral channel; incised with little change in shrub density
4.6 - 5.8	1.2	10.9	Sagebrush/Grassland	Gently sloping area includes a highway
Road crossing bore pits		1.1	Sagebrush/Grassland	
5.9 - 7.7	1.8	16.4	Oesert Shrub	
7.7 - 8.6	0.9	8.2	Riparian	Dugout Creek; dense shrubby bottomland; pond at milepost 8.2 south of pipeline this pond and south of another one which is adjacent to the road
8.6 - 9.1	0.5	4.6	Oesert Shrub	Incised drainage at base of bluff has very little vegetation change; salt precipitation on west facing slope soils
9.1 - 9.2	0.1	0.9	Sagebrush/Grassland	Near but will not disturb pond to north of the road.
Origin Station		0.1	Sagebrush/Grassland	
Wellfield Total		1774.5	Undetermined (b)	
Pipeline Totals	4.0	76.6	Desert Shrub (d)	
	1.8	17.9	Sagebrush/Grassland (e)	
	1.9	17.3	Grassland	
	1.5	13.7	Riparian	
		N.O.	Disturbed	
		0.1	Undetermined (f)	
Total Oisturbance	9.2	1900.1		

a = Source: Mileages are derived from Vegetation Maps SC-1 through SC-5.
Since .1 mile is the smallest distance delineated, the width of riparian areas is slightly exaggerated.
b = Estimated disturbance for replacement of production and injection pipelines; location of pipelines is not yet determined.
c = Indented mileages indicate riparian areas, usually ephemeral drainages, within the range of another vegetation type.
d = Acreage includes recycle plant and meter station.
e = Acreage includes road crossing pits and origin station.
f = Acreage includes block valve

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SOILS, VEGETATION AND AGRICULTURE
TECHNICAL REPORT
CHAPTER THREE:
ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION AND ASSUMPTIONS

In order to evaluate the impacts of the projects on soils, vegetation and agriculture, assumptions were made about project design and implementation. First, it is assumed that pipeline construction would disturb a uniform 75-foot-wide corridor. While the entire right-of-way would be 75 feet wide, disturbance will actually be minimized in most areas by limiting blading and clearing to those places necessary to provide a safe working surface. Safety requires a cleared area for welding pipe (i.e., to avoid brush fires) and a level surface for the ditching equipment. In steep terrain, however, sideslope cuts will require disturbance of more than 75 feet to create a level working surface. On federal land where more than 75 feet is required for construction, Amoco would need a BLM Temporary Use Permit.

The description of the project (EIS Chapters 1 and 2) does not include specific techniques to be used for reclamation in areas of various terrain, soils and vegetation types. These site-specific techniques will be included in the Plans of Development which must be approved before the right-of-way is granted. Therefore, estimates of erosion and the probability of reclamation success on disturbed areas assumes that Amoco will comply with BLM's "Provisions and Measures Designed to Reduce Environmental Impacts" (See Appendix 1 of the EIS). Amoco's Plans of Development would incorporate the general commitments of the "Provisions and Measures" document and add specific BLM requirements before the company receives final authorization. It is also assumed for this analysis that when operating on state or private land, techniques used to control impacts would be at least as effective as those implemented on federal land and that landowner permission will be obtained for access to private land.

The analysis assumes that all approved reclamation measures will be "best practices" for the specific conditions of the sites and that appropriate personnel (either Amoco's or BLM's) will be available on-site to assure that impact control measures are properly implemented. Some of the on-site decisions would include determining when topsoil is considered adequate to segregate it from subsoil, when the ground is too wet to support equipment without damaging soil structure and when disturbance areas require more than the standard reclamation techniques to avoid excessive erosion.

Table 3-1 compares soil lost on a given area 1) without construction, 2) when disturbance is reclaimed in the fall of the year of disturbance, and 3) when reclamation is postponed until fall of the following year. It is evident from the comparison that disturbance accelerates erosion and that steep slopes are particularly susceptible to increased soil loss. The table also illustrates the benefits of erosion control materials applied in the interim between disturbance and reseeding.

The Plans of Development would include a weed control program that would control poisonous plants, noxious weeds and other invader plants such as annual weeds.

Table 3-1. Universal Soil Loss Equation Sample Calculations for Disturbed and Undisturbed Areas. (a)

									Tons per Acre of Erosion								
		C (c)							Without Construction (Per Year)	Seeded in Fall (d)			Reseeding Delayed (e)		2-Year Erosion Totals (Tons Per Acre)		
										Year 1		Year 2	Year 1	Year 2	Seeding in Fall		Reseeding Delayed No Mulch Used
Description	R (b)	1	2	3	4	5	K	LS		With Mulch	W/O Mulch				With Mulch	W/O Mulch	
FONTENELLE PROJECT																	
Standard values	20	1.20	0.64	0.54	0.04												
Slate Creek Soil L313; 325'@ 30% slope; 25% shrub cover, 20% grass						0.17	0.05	14	2.4	3.2	9.1	7.7	10.9	15.0	11.0	16.8	25.9
ELK BASIN PROJECT																	
Standard values	20	1.20	0.64	0.54	0.04												
Badlands near Sheep Mountain Soil BH471; 400'@ 20% slope; 25% shrub cover, 0% grass						0.36	0.37	8.0	21.3	12.3	52.1	32.1	56.1	67.1	44.5	84.3	123.2
Soil BH471; 40'@ 50% slope; 25% shrub cover, 0% grass						0.36	0.37	11.0	29.3	16.9	71.7	44.2	77.2	92.2	61.1	115.9	169.4
BEAVER CREEK PROJECT																	
Standard values	20	1.20	0.64	0.54	0.04												
Beaver Divide Soil F277; 650'@ 15% slope; 25% shrub cover, 20% grass						0.17	0.37	6.5	8.2	8.1	33.2	26.1	36.4	54.5	34.1	59.3	90.9
Soil F277; 650'@ 30% slope; 25% shrub cover, 20% grass						0.17	0.37	20.0	25.2	24.8	102.1	80.2	112.1	167.7	105.1	182.3	279.7
LITTLE BUFFALO BASIN PROJECT																	
Standard values	20	1.20	0.64	0.54	0.04												
Bluff between Gooseberry and Buffalo Creeks Soil HS322; 400'@ 20% slope; 25% shrub cover, 20% grass						0.17	0.24	8.0	6.5	6.4	26.5	20.8	29.1	43.5	27.3	47.3	72.6

Table 3-1. Continued.

Description	R (b)	C (c) 1	C (c) 2	C (c) 3	C (c) 4	C (c) 5	K	LS	Tons per Acre of Erosion: Without Construction (Per Year)	Seeded in Fall (d): Year 1 With Mulch	Seeded in Fall (d): Year 1 W/O Mulch	Seeded in Fall (d): Year 2	Reseeding Delayed (e): Year 1	Reseeding Delayed (e): Year 2	2-Year Erosion Totals (Tons Per Acre): Seeding in Fall With Mulch	2-Year Erosion Totals (Tons Per Acre): Seeding in Fall W/O Mulch	2-Year Erosion Totals (Tons Per Acre): Reseeding Delayed No Mulch Used
SALT CREEK PROJECT																	
Standard values	20	1.20	0.64	0.54	0.04												
Salt Creek Field Soil 125; 400'@ 15% slope; 20% grass cover						0.2	0.43	5	8.6	7.8	30.2	23.3	33.1	48.7	31.1	53.5	81.8

a = The Universal Soil Loss Equation is A = R * K * LS * C, where
    A = soil loss in tons/acre
    R = rainfall factor
    K = erodibility factor of surface horizon
    LS = length-slope factor
    C = cover and erosion control practices factor
    Source: Barfield et al, 1987
b = R is proportioned by geographic area and assumes disturbance in year 1 on 6/1, seeding on 10/1 and good germination on 4/1 of year 2;
    if seeding is delayed, it is delayed until 10/1 of year 2.
c = C1 = bare, bulldozer compacted
    C2 = seeded but before germination
    C3 = good germination after reseeding
    C4 = mulched with wood fiber or asphalt emulsion immediately after disturbance
    C5 = native vegetation
d = Disturbed areas reseeded in fall of the year disturbed
e = Disturbed areas not reseeded until fall of the year following construction

This program is required by the "Provisions and Measures" and must be in compliance with federal, state and local regulations or acceptable to the applicable landowner.

3.1.1 <u>Soils and Vegetation</u>

3.1.1.1 <u>Potential Impacts and Control Measures</u>. Impacts to soils and vegetation resources would primarily result from land disturbing activities including construction of facilities. Since existing roads are considered adequate for access to the right-of-way, disturbance should be confined to the right-of-way, staging areas for road and river crossings, additional areas needed for construction in steep terrain (Temporary Use Permits required) and wellfield-related activities (requiring approval under the BLM Sundry Notice Process).

Most of these impacts will be short-term since all disturbed areas not needed for operations will be reclaimed within a year of construction. Most reclamation will be completed within a few months of disturbance. With effective use of standard BLM impact control and mitigation measures, understory vegetation in sites without special problems is expected to return to near-preconstruction conditions within five years after construction. Overstory vegetation would take longer to become established, e.g., 10 to 20 years for Sagebrush types, 20 to 30 years for Desert Shrub vegetation and 50 to 75 years for Coniferous Woodland tree species (BLM, 1985a).

Some adverse effects of construction and operations will occur in all the projects. The significance of the impact of a project on the existing system will, however, depend on both baseline conditions and impact control and mitigation measures implemented at each site. Effects specific to a particular project are discussed in each project section. The direct, adverse effects which will, to some degree, accompany all construction, are summarized below. General measures which would be used to minimize impacts are included with each.

- Compaction of soil on the right-of-way by construction equipment and construction workers' vehicles;
  - Minimize travel on the right-of-way; rip compacted areas prior to revegetation; construct barriers to limit use after construction; restrict right-of-way travel to essential maintenance;
- Alteration of the soil profile in all excavation areas;
  - Segregate topsoil and subsoil where adequate topsoil exists;
- Potential reduction in soil stability in steep slope areas;
  - Implement steep slope erosion control measures; closely monitor effectiveness and implement remedial action when necessary;
- Accelerated wind and water erosion on unsurfaced access roads during wet weather and in construction areas until revegetation or erosion control measures are implemented;
  - Limit construction in wet weather; implement erosion control measures without delay;

- o Loss of vegetation productivity for the period of construction and until regrowth and plantings restore productivity;

  - Limit grading to areas required for safe worksite; maintain clean worksite (e.g., proper disposal of waste oil, scrap pipe, etc); use "best practices" for revegetation;

- o Increased instability of stream banks with removal of riparian vegetation;

  - Leave stream buffer zone for river crossings; use mechanical bank stabilization where appropriate (riprap, erosion blanket, etc); implement special practices for riparian area revegetation;

- o Damage to vegetation in areas where steep slope construction requires side cuts and fills;

  - Minimize cut and fill areas;

- o Off-site loss of vegetation productivity due to increased off-road vehicle use in the construction area;

  - Limit construction worker travel to right-of-way; discourage illegal ORV use of workers; and

- o Invasion of weeds onto disturbed right-of-way soils and their potential introduction into other relatively weed-free areas;

  - Implement weed control program where necessary.

3.1.1.2. Significance Criteria. Impacts to soils and vegetation were considered significant if:

- o The loss of soil and reduction of soil productivity and stability prevented successful restoration and recovery to near preconstruction conditions within five years;

- o Following construction, more than five years were required to reestablish a ground cover to near preconstruction densities or if any poisonous or noxious plants become established where none existed before construction; and

- o Any federally listed threatened or endangered plant species or sensitive plant species (candidate and state rare species and rare plant associations) were affected or lost.

Table 3-2 indicates the acreage of each vegetation type to be disturbed by construction of the projects. This table summarizes data presented in Chapter 2 for each project (Tables 2-13, 2-16, 2-19, 2-22 and 2-25).

3.1.2 Agriculture

3.1.2.1 Potential Impacts and Control Measures. Impacts to agriculture would be primarily direct impacts from land disturbing activities including construction and operation of facilities and the indirect disruption of agricultural activities or livestock due to the presence of construction workers. Since existing roads are considered adequate for access to the right-

Table 3-2. Acreage of Vegetation Disturbed During Pipeline and Plant Construction. (a)

	Fontenelle		Elk Basin		Beaver Creek		Little Buffalo		Salt Creek		Total	
Vegetation Type	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term	Short-Term	Long-Term
Sagebrush/Grassland	543.6	191.8	848.8	40.6	262.7	40.3	163.4	40.2	17.9	0.1	1836.4	313.0
Desert Shrub	11.8	0.6	481.6	0.3			87.1	0.1	36.4	40.2	617.0	41.2
Grassland	13.7	26.1	31.8		63.9				17.3		126.8	26.1
Coniferous Woodland					3.6		11.8				15.5	0.0
Mixed Shrub			49.1	0.1	18.2						67.3	0.1
Riparian	16.8	31.7	98.1		56.0		36.4		13.7		221.0	31.7
Cropland			88.5	0.2			26.4				114.9	0.2
Barren/Badlands			24.6				0.9				25.5	0.0
Disturbed				(b)		(b)		(b)		(b)	0.0	(b)
Undetermined			14.7			0.2		0.2		0.1	ERR	0.5
Totals	586.0	250.2	1637.3	41.2	404.4	40.5	326.0	40.5	85.2	40.4	ERR	412.8

a = Source: Table derived from Vegetation Maps and Tables 2-13, 2-16, 2-19, 2-22 and 2-25.
b = Amount of disturbed area to be redisturbed is unknown.

of-way, disturbance should be primarily confined to the right-of-way, as described in the previous section. Most of these impacts will be short-term since priority will be given to restoring agricultural facilities (e.g., irrigation diversions and fences) and all disturbed areas not needed for operations will be reclaimed within a year of construction. Most reclamation will be completed within a few months of disturbance.

Some adverse effects of construction and operations on agriculture will occur in all the projects. The significance of the impact will, however, depend on both baseline conditions and impact control and mitigation measures implemented at each site. Effects specific to a particular project are discussed in each project section. The direct, adverse effects which will, to some degree, accompany all construction, are summarized below. General measures which would be used to minimize these impacts are included with each.

- o Short- and long-term loss of cropland and cropland productivity in the right-of-way;
  - Minimize equipment traffic; segregate soil horizons; implement other "best practices" reclamation techniques; plant in spring if appropriate; compensate landowners for lost crop revenues;
- o Loss of forage for the period of construction and until regrowth and plantings restore productivity;
  - Implement "best practices" reclamation techniques; compensate private landowners for lost revenues;
- o Interference with livestock access to watering areas;
  - Maintain functional use of all watering devises during construction; provide trench crossings for water access with one day of access obstruction or provide alternate water source;
- o Loss of livestock in open trenches;
  - All ditches would be closed within 14 days; provide trench crossings in cattle trailing areas; compensate owners for loss of cattle;
- o Loss of agricultural productivity due to transportation delays and other disruptions of operations;
  - Notify users and landowners in advance of construction activities; maintain or replace fences and gates to preconstruction condition;

3.1.2.2. **Significance Criteria**. Impacts to agriculture were considered significant if:

- o The amount of forage lost to grazing within an allotment exceeded 1 percent of the licensed forage in the allotment;
- o The amount of forage lost reduced livestock stocking rates by 1 percent or more in affected allotments;
- o Project construction allowed an open trench or other obstructions (without crossings) which prevented livestock access to water for periods of more

than one day or disrupted grazing patterns for periods greater than two weeks;

- o The long-term productivity of more than 1 percent of the cropland in counties containing project components would be diminished;
- o More than five acres of cropland would be irreversibly converted to other uses beyond the life of the project; and
- o Cropland outside of the project area would be affected to the extent that more than 5 percent of the total cropland in the area was irreversibly converted to other uses because of project development.

Table 3-3 summarizes cropland that would be disturbed by construction of the projects. Tables in each of the following project sections present estimates of forage loss from construction and operation activities.

3.2 FONTENELLE CO_2 SUPPLY PROJECT

3.2.1 Soils and Vegetation

Table 3-2 provides estimated acreage of each vegetation type to be disturbed by construction of the Fontenelle Project. About 586 acres will be temporarily disturbed and about 250 acres, mostly wellfield roads, will be disturbed for the life of the project. Sagebrush/Grassland, the most common vegetation type in the vicinity, constitutes over 90 percent of the short-term disturbance and over 75 percent of the long-term disturbance. Sagebrush/Grassland areas pose no particular problem for reclamation. Much of the Desert Shrub community, however, occupies shallow soil with low permeability. Soils of the plant site are deep but fine textured with both permeability and salinity problems. Most of the site supports a Greasewood community (a subtype of the Riparian Vegetation Type). Coupled with low precipitation (averaging only 8 inches per year), these communities (about 7 percent of all disturbance) will be more difficult to reestablish.

The gentle terrain of most of the area will limit accelerated erosion. However, special attention to erosion control in the area of Slate Creek is necessary to prevent accelerated sediment contribution to the Green River.

The majority of the 49 acres of Riparian vegetation which will be disturbed during construction is associated with ephemeral drainages although about 4.3 acres will be disturbed at the Green River crossing. About 0.2 acre of this disturbance will be for block valves which will be used for the life of the project. The particular crossing location was chosen because other utility lines have used the same location, i.e., the crossing has already been disturbed. Special erosion control and revegetation efforts at the river crossing are necessary to minimize impacts to the river and its banks.

There are no threatened, endangered or proposed plant species in the vicinity of the Fontenelle CO_2 Supply Project. While several candidate species have been identified in southwestern Wyoming, all are relatively widespread and no known populations are within ten miles of the project. The Fontenelle CO_2 Supply Project should not adversely affect any rare plant species.

Table 3-3. Crop Statistics by Project and County.

Project Component	County (a)	Total Cropland (Acres) (b)	Cropland Disturbed (Acres) (c)		Cropland Disturbed (% of Total)	
			Short-Term	Long-Term	Short-Term	Long-Term
Wellfields and Recycle Plants						
Elk Basin	Park	97,000	0	0	0	0
Little Buffalo Basin	Hot Springs	21,450	0	0	0	0
	Park	97,000	0	0	0	0
Salt Creek	Natrona	27,600	0	0	0	0
Beaver Creek	Fremont	119,900	0	0	0	0
Fontenelle Processing Plant	Sweetwater	18,600	0	0	0	0
Pipelines						
Fontenelle Gas Gathering System	Lincoln	99,600	0	0	0	0
	Sweetwater	18,600	0	0	0	0
Elk Basin	Park	97,000	9.1	0	0.01	0
	Big Horn	90,900	50.1	0.1	0.06	< .01
	Washakie	43,850	15.6	0	0.04	0
	Hot Springs	21,450	0	0	0	0
	Fremont	119,900	4.6	0	0	0
	Natrona	27,600	9.1	0.2	0.03	< .01
Beaver Creek	Fremont	119,900	0	0	0	0
Little Buffalo Basin	Hot Springs	21,450	19.1	0	0.09	0
	Washakie	43,850	7.3	0	0.02	0
Salt Creek	Natrona	27,600	0	0	0	0
SUMMARY FOR PROJECT COUNTIES		518,900	114.9	0.3	0.02	< .01

a = Only Wyoming Counties are listed since there is no cropland affected in Montana.
b = Source: 1985 data from Wyoming Agricultural Statistics, 1986 Yearbook, most recent published data.
c = Short-term refers to areas disturbed during constuction and rehabilitated following construction.
Long-term refers to acreage removed from use for the life of the project.

3.2.2 Agriculture

No cropland or field or farmstead windbreaks will be directly affected by project construction. Since the inmigrant workforce is relatively small compared to its anticipated place of residence (Green River), no conversion of cropland to other land uses as a result of urban expansion is expected (see the Socioeconomic Technical Report for a complete discussion).

Table 3-4 summarizes long- and short-term loss of forage due to construction and operation of the Fontenelle Project. Because of the relatively low productivity of the area (8 to 25 acres per AUM of forage) very few AUMs will be lost. About 43 AUMs would be lost for the short-term and 22 AUMs per year lost for the life of the plant and wellfield. This disturbance amounts to less than one-half of 1 percent of any affected grazing allotment. The impact on the allotment stocking rates would be less than one animal per allotment or about 0.28 percent of the minimum stocking rate in the most severely affected allotment (Kemmerer Resource Area allotment #1112).

No stock watering areas would be directly affected by construction. Significance of indirect effects will be mitigated by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone.

3.3 ELK BASIN CO_2 PROJECT

3.3.1 Soils and Vegetation

About 1,678 acres would be disturbed during construction of the Elk Basin Project. Much of the route is relatively level or gently rolling but there are three major areas of steep or dissected terrain that would be crossed: the vicinity of Sheep Mountain, Zimmerman Butte area and Kirby Creek area near Lysite Mountain (see Appendix A, Table A-9). Special attention to erosion control in these areas is necessary to limit erosion and increase the likelihood of revegetation success.

Most of the right-of-way soils have other limiting features, with over 100 miles having shallow soil and/or low permeability limitations. Since annual precipitation ranges from a low of 5 inches in the Big Horn Basin to about 12 inches in Bridger/Kirby Creeks area, reclamation techniques which enhance permeability and conserve available moisture would increase the potential for successful revegetation.

Table 3-4. Estimated Short-Term and Long-Term Loss of Forage for the Fontenelle Gas Gathering System and CO2 Processing Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Kemmerer	1112	1272	0.10	7.4 - 9.7	20.9	Block valve	0.1	5.71	0.00	5.71	0.45	0.00	0.28
				1.7w - 3.2w (e)	13.7	Well operations	1.0						
				5.9w - 7.2w	11.8								
				Staging area (f)	1.1								
				Road bore pit	0.6								
				Drill pads (g)	9								
	1113	11493	0.04	.5 - 7.4	62.8	1.4 mi. road	8.5	4.18	0.34	4.52	0.04	0.00	0.02
				0w - 1.7w	15.5								
				3.2w - 5.9w	24.6								
				Road bore pit	1.7								
	1306	30924	0.12	0 - .5	4.6	Plant site	40.0	0.55	5.96	6.51	0.00	0.02	0.02
						1.6 mi. road	9.7						
Green River	18 Mile	18994	0.08	13.4 - 16.8	30.9	Field roads	181.8	30.80	15.26	46.06	0.16	0.08	0.09
				Gas gathering	273.0	Well operations	9.0						
				Drill pads (g)	81.0								
	Lombard	6644	0.07	9.7 - 13.4	30.9	Block valve	0.1	2.25	0.01	2.25	0.03	0.00	0.03
				Staging area (f)	1.1								
							TOTALS:	43.48	21.57	65.06			

a = Source: Mileages calculated from Vegetation maps F-1 through F-3 and BLM data. See also Table 2-9

b = Short-term disturbances include all construction that will be reclaimed upon completion.

c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.

d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.

e = Gas gathering system for west side of reservoir.

f = Green River Crossing.

g = Assumes 9 wells east of the reservoir and 1 well west of the reservoir.

Table 3-2 provides estimated acreage of each vegetation type to be disturbed by trunk pipeline and recycle plant construction. About 1,637 acres will be temporarily disturbed and about 41 acres will be disturbed for the life of the project. Sagebrush/Grassland constitutes about 65 percent of the short-term disturbance and almost all of the long-term disturbance. Desert Shrub vegetation accounts for 30 percent of the short-term disturbance.

About 98 acres of Riparian area will be disturbed in the short-term. Most of this disturbance will be at ephemeral drainage crossings. More diverse riparian zones will be disturbed at the perennial stream crossings and three river crossings, although the river crossing areas are primarily Cropland. All proposed river crossing locations were chosen because they are within existing pipeline corridors and have been previously disturbed by pipeline construction.

With appropriate attention to limiting impacts (e.g., maintaining a buffer zone between the river banks and staging areas) and to revegetation, the corridor disturbance through the riparian zone can be reclaimed. With the supplemental water associated with the zone, revegetation success is more likely in the riparian zone than in the adjacent uplands.

A long-term decrease in riparian vegetation may occur in Silver Tip Creek from a decrease in surface discharge of produced water.

An additional 683 acres of disturbance is estimated for replacement of producing and injection pipelines within the Elk Basin Field. Since the location of pipelines that would require replacement is not currently known, the impact on each vegetation type cannot be estimated at this time.

There are no threatened, endangered or proposed plant species in the vicinity of the Elk Basin CO_2 Project, but two candidate species, Porter's sagebrush and the Owl Creek Miner's Candle, are known from the vicinity of the pipeline. Since a plant survey has not been conducted for the pipeline right-of-way, sufficient information is not available to evaluate impacts of pipeline construction on these species. Before final authorization of the project, a survey, based on available location and habitat data, would be conducted for these species. If a conflict between the plants and pipeline is identified, appropriate mitigation measures would be developed to assure that project construction would not adversely impact the candidate species.

3.3.2 Agriculture

Summary Table 3-3 indicates that about 89 acres of cropland will be disturbed. This includes about 38 acres of prime farmland. Fifteen additional disturbed acres of prime farmland soils are not currently being farmed. The total disturbance of cropland accounts for less than 0.1 of 1 percent of cropland in each county. This disturbance includes 0.2 acre of long-term cropland disturbance, 0.1 acre in Natrona County for the origin station and 0.1 acre in Big Horn County for a block valve. The block valve would be located adjacent to a road near cropland.

In addition to cropland directly disturbed by construction, productivity of adjacent cropland may be affected in the season of construction by limiting availability of irrigation water while diversion ditches are interrupted. This impact can be minimized if irrigators are given sufficient notification of construction schedules and repair of diversions is expedited. Revegetation of the ditch crossings will require special attention to prevent future erosion.

It is assumed that both directly and indirectly affected landowners will be compensated for production loss due to the project construction.

The quantity of surface water currently available for irrigation and stock watering would be reduced by the project since the Elk Basin CO_2 flood would be a miscible flood. The wellfield-produced water that is currently discharged to the surface would be virtually eliminated.

No field or farmstead windbreaks will be directly affected by project construction. No conversion of cropland to other land uses as a result of urban expansion is anticipated since the expected areas of residence for inmigrant construction workers would have sufficient capacity to absorb workers without additional construction (see the Socioeconomic Technical Report for a complete discussion).

Table 3-5 summarizes expected long- and short-term loss of forage due to construction and operation of the Elk Basin Project. About 166 AUMs would be lost for the short-term and less than 3 AUMs per year lost for the life of the plant and pipeline facilities (i.e., recycle plant, block valves, origin and meter stations). Short-term disturbance is significant (i.e., more than 1 percent of licensed forage) on 21 percent (9) of the affected allotments. Four of these are small allotments (less than 50 AUMs per allotment) (Grass Creek #0549, Washakie #2513, Lander #1357 and Platte River #0008) and one (Cody #1003) includes most of the wellfield disturbance. The latter is also the location of the recycle plant. No long-term impacts are greater than 1 percent of licensed forage. The short-term impact on the allotment stocking rates would be greater than 1 percent on four allotments.

The proposed trunk pipeline route is in close proximity to several stock water improvements built on drainages crossed by the pipeline, but none would be directly affected by construction. All water improvements will be kept functional during construction. Significance of indirect effects will be mitigated by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone.

3.4 BEAVER CREEK CO_2 PROJECT

3.4.1 Soils and Vegetation

About 445 acres would be disturbed in construction of the Beaver Creek Project. The most severe erosion control and reclamation problem will be in the approximately 1.5 miles of steep terrain crossing Beaver Divide. The area has already been disturbed during development of the Big Sand Draw Oil Field. Since this is also a landslide area, special erosion control measures will be needed to assure reclamation success.

Most of the right-of-way soils have other limiting features. About half have shallow soil and/or low permeability limitations. With these soils and an annual precipitation averaging 9 to 12 inches, revegetation should be feasible. Reclamation techniques which enhance permeability would increase the potential for successful revegetation.

Table 3-5. Estimated Short-Term and Long-Term Loss of Forage for the Elk Basin Trunk Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Cody	0666	755	0.11	36.7 - 40.3	31.8			3.49		3.49	0.46		0.06
	1003	1143	0.06	0 - 1.9	17.29	Recycle plant	40.0	38.30	2.412	40.71	3.35	0.21	2.37
				Wellfield (e)	621.08	Meter station	0.2						
	1060	3885	0.07	29.0 - 36.7	70.1			4.90		4.90	0.13		0.03
	1061	200	0.03	8.7 - 12.8	4.1	Block valve	0.1	0.12	<.01	0.13	0.06	<.01	0.02
	1080	4463	0.08	1.9 - 8.7	61.9			9.86		9.86	0.22		0.06
				Wellfield (e)	61.43								
	1086	309	0.06	40.3 - 42.5	20.0			1.27		1.27	0.41		0.09
				Road bore pits	1.1								
	No allotment			12.8 - 29.0	147.4	Block valve	0.1						
				Road bore pits	2.3								
				43.5 - 44.3	7.3								
				Staging area (f)	2.3								
				Staging areas (g)	3.4								
Grass Creek	0508	7271	0.06	66.6 - 83.0	149.2			8.95		8.95	0.12		0.11
	0509	7663	0.08	49.1 - 66.6	159.3	Block valve	0.1	12.74	0.01	12.75	0.17	<.01	0.08
	0512	726	0.06	83.0 - 85.5	22.8	Block valve	0.1	1.37	0.01	1.37	0.19	<.01	0.08
	0549	27	0.08	44.3 - 44.8	4.6			0.36		0.36	1.35		0.03
	0674	1092	0.10	47.1 - 47.2	0.9			0.09		0.09	0.01		<.01
	No allotment			44.8 - 47.1	28.2	Block valve	0.1						
				47.2 - 49.1	17.3								
				85.5 - 87.6	19.1								
				Road bore pits	1.1								
				Staging area (h)	2.3								
Washakie	0048	2075	0.08	87.6 - 93.2	51.0			4.08		4.08	0.20		0.08
	0501	2957	0.20	98.8 - 106.5	70.1	Block valve	0.1	14.01	0.02	14.03	0.47	<.01	0.30
	0562	1934	0.17	97.7 - 98.8	10.0			1.70		1.70	0.09		0.01
	0571	503	0.12	95.8 - 96.1	2.7			0.33		0.33	0.07		0.01
	0591	476	0.09	96.1 - 97.7	14.6			1.31		1.31	0.28		0.07
	0603	431	0.19	93.2 - 95.8	23.7			4.50		4.50	1.04		0.17
	2513	30	0.12	112.9 - 114.2	11.8			1.42		1.42	4.73		4.73
	2514	473	0.05	109.6 - 109.8	1.8			2.78		2.78	0.59		0.59
				110.0 - 111.3	11.8								
				112.4 - 112.9	4.6								
				114.2 - 118.3	37.3								
	2542	96	0.22	111.3 - 112.4	10.0			2.20		2.20	2.29		2.29
	2543	156	0.22	108.6 - 109.6	9.1			2.40		2.40	1.54		1.54
				109.8 - 110.0	1.8								
	2547	396	0.18	106.5 - 108.6	19.1			3.44		3.44	0.87		0.58

Table 3-5. Continued.

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Lander	1312	2820	0.11	137.4 - 143.4	54.6	Block valve	0.1	6.01	0.01	6.02	0.21	<.01	0.21
	1315	108	0.08	133.8 - 134.2	3.6			0.29		0.29	0.27		0.01
	1316	170	0.06	134.2 - 136.3	19.1			1.15		1.15	0.67		0.11
	1322	726	0.16	136.3 - 137.4	10.0			1.60		1.60	0.22		0.18
	1325	272	0.04	129.0 - 133.8	43.7			1.75		1.75	0.64		0.13
	1332	159	0.05	128.6 - 129.0	3.6			0.18		0.18	0.11		0.04
	1337	125	0.02	118.3 - 122.4	37.3			0.75		0.75	0.60		0.60
	1353	416	0.05	123.2 - 126.1	26.4	Block valve	0.1	1.32	0.01	1.32	0.32	<.01	0.32
	1355	673	0.08	126.1 - 128.6	22.8			1.82		1.82	0.27		0.05
	1357	32	0.06	122.4 - 123.2	7.3			0.44		0.44	1.37		0.11
Platte River	0006	125	0.08	161.8 - 162.7	8.2	Block valve	0.1	0.80	0.01	0.81	0.64	0.01	0.13
				163.3 - 163.5	1.8								
	0007	229	0.11	163.5 - 167.9	40.0			4.40		4.40	1.92		0.40
	0008	16	0.01	158.0 - 161.8	34.6			0.35		0.35	2.16		0.18
	0013	1478	0.16	151.6 - 155.7	37.3			5.97		5.97	0.40		0.17
	0037	3734	0.10	155.7 - 158.0	20.9			5.57		5.57	0.15		0.15
				168.2 - 170.5	20.9								
				Road bore pits	1.1								
				174.4 - 175.8	12.7								
	0066	1232	0.11	147.8 - 151.6	34.6			3.80		3.80	0.31		0.21
	0130	1038	0.46	162.7 - 163.3	5.5			3.77		3.77	0.36		0.36
				167.9 - 168.2	2.7								
	0134	641	0.14	175.8 - 176.8	7.3	Origin station	0.1	1.02	0.01	1.03	0.16	<.01	0.16
	0148	3193	0.13	143.4 - 147.8	4.4			0.57		0.57	0.02		0.02
	0523	1270	0.14	170.5 - 174.4	35.5			4.97		4.97	0.39		0.39
							TOTALS:	166.15	2.48	168.64			

a = Mileages calculated from Vegetation maps EB-1 through EB-40 and BLM data. See also Table 2-9.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 91% of field in allotment #1003, 9% of field in allotment #1080.
f = Greybull River crossing staging area.
g = Shoshone River crossing and Sidon Canal boring staging areas.
h = Bighorn River crossing staging area.

Table 3-2 provides estimated acreage of each vegetation type to be disturbed by trunk pipeline and recycle plant construction. About 404 acres will be temporarily disturbed and about 41 acres will be disturbed for the life of the project. Sagebrush/Grassland constitutes about 65 percent of the short-term disturbance and almost all of the long-term disturbance.

About 56 acres of Riparian area will be disturbed in the short-term. Most of this disturbance will be in ephemeral drainage crossings. More diverse riparian zones will be disturbed on the Sweetwater River, Ice Slough and Crooks Creek. One riparian area near the Sweetwater River and one near Crooks Creek could be avoided if blading in the area were limited.

An additional 228 acres of disturbance is estimated for replacement of producing and injection pipelines within the Beaver Creek Field (see Table 1-2). Since the location of pipelines that would require replacement is not currently known, the impact on each vegetation type cannot be estimated at this time.

There are no threatened, endangered or proposed plant species in the vicinity of the Beaver Creek CO_2 Project, but two candidate species, Porter's sagebrush and the Meadow pussytoes, are known from the vicinity of the trunk pipeline. Since a plant survey has not been conducted for the pipeline right-of-way, sufficient information is not available to evaluate impacts of pipeline construction on these species. Before final authorization of the project, a survey, based on available location and habitat data, would be conducted for these species. If a conflict between the plants and pipeline is identified, appropriate mitigation measures would be developed to assure that project construction would not adversely impact the candidate species.

3.4.2 Agriculture

No cropland or field or farmstead windbreaks will be directly affected by project construction, although the Sweetwater River riparian zone is agricultural, if not strictly cropland. No conversion of cropland to other land uses as a result of urban expansion is expected in the Riverton area, the expected area of residence for immigrant construction workers (see the Socioeconomic Technical Report for a complete discussion).

Table 3-6 summarizes expected long- and short-term loss of forage due to construction and operation of the Beaver Creek Project. About 69 AUMs would be lost for the short-term and only about 5 AUMs lost for the life of the plant and pipeline facilities (i.e., recycle plant, block valves, origin and meter stations). The total disturbance (long and short-term) is less than 1 percent of licensed forage on all allotments. The impact on the allotment stocking rates would be less than one-half of 1 percent of current rates.

The proposed trunk pipeline route is in close proximity to several stock water improvements but none would be directly affected by construction. Significance of indirect effects will be mitigated by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone. The quantity of water currently available for stock watering would, however, be reduced by the project since the Beaver Creek CO_2 flood would be a miscible flood. The wellfield-produced water that is currently discharged to the surface would be virtually eliminated.

Table 3-6. Estimated Short-Term and Long-Term Loss of Forage for the Beaver Creek Trunk Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Lander	1703	14122	0.14	13.3 - 24.7	103.7			14.52		14.52	0.10		0.06
	1704	1956	0.11	25.1 - 29.3	38.2			4.20		4.20	0.21		0.17
	1707	183	0.08	29.6 - 30.8	10.9			0.87		0.87	0.48		0.12
	1715	14	0.03	29.3 - 29.6	2.7			0.08		0.08	0.59		0.22
	1801	8824	0.11	0 - 8.8	80.1	Recycle plant	40.0	30.46	4.42	34.88	0.35	0.05	0.20
				Road bore pits	1.1	Meter station	0.2						
				Wellfield (e)	195.7								
	1802	1163	0.08	8.8 - 13.3	41.0			3.28		3.28	0.28		0.11
	1805	734	0.11	Wellfield (e)	13.7			1.50		1.50	0.20		0.09
	1812	516	0.03	Wellfield (e)	18.2			0.55		0.55	0.11		0.05
	2001	47340	0.15	33.9 - 35.4	13.7	Origin station	0.1	3.41	0.02	3.43	0.01	<.01	0.00
				41.4 - 41.7	2.7								
				43.8 - 44.5	6.4								
	2004	651	0.10	30.8 - 31.6	7.3			2.18		2.18	0.34		0.32
				32.3 - 33.9	14.6								
				Road bore pits	1.1								
	2011	296	0.16	31.6 - 32.3	6.4			1.02		1.02	0.34		0.04
	2012	377	0.07	37.3 - 41.4	37.3			2.61		2.61	0.69		0.06
	2013	1727	0.13	35.4 - 37.3	17.3			2.25		2.25	0.13		0.07
	2023	67	0.10	41.7 - 43.8	19.1			1.91		1.91	2.85		0.24
	No allotment			24.7 - 25.1	3.6								
				Staging area (f)	2.3								
	Unknown					Block valve (g)	0.1		0.02	0.02			
							TOTALS:	68.85	4.45	73.30			

a = Source: Mileages calculated from Vegetation maps 8C-1 through 8C-10 and BLM data. See also Table 2-9.

b = Short-term disturbances include all construction that will be reclaimed upon completion.

c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.

d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.

e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 86% of the field in allotment #1801, 8% in allotment #1812 and 6% in allotment #1805.

f = Sweetwater River crossing staging area.

g = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.16) was used to estimate forage loss.

3.5 LITTLE BUFFALO BASIN CO_2 PROJECT

3.5.1 Soils and Vegetation

About 367 acres would be disturbed during construction of the Little Buffalo Basin Project. The proposed route, which follows an abandoned pipeline corridor along Gooseberry Creek, avoids most of the steep, badlands terrain in the area. The steep areas traversed are primarily at the entrance to Little Buffalo Basin and in the vicinity of Hillberry Rim, areas which have been traversed by other pipelines and which would be difficult to avoid. Because of the proximity of these steep areas to Gooseberry and Buffalo Creeks, special erosion control measures are necessary to limit accelerated erosion and prevent accelerated sediment contribution to the agricultural areas.

Shallow soils, low permeability and high salinity are characteristic limitations of much of the area. Even the prime farmland soils have permeability and high water table limitations. With these soil limitations and annual precipitation averaging 7 to 10 inches, revegetation should be feasible.

Table 3-2 provides estimated acreage of each vegetation type to be disturbed during spur pipeline and recycle plant construction. About 326 acres will be temporarily disturbed and about 41 acres will be disturbed for the life of the project. Sagebrush/Grassland constitutes about 50 percent of the short-term disturbance and almost all of the long-term disturbance. About 27 percent of the short-term disturbance is in the Desert Shrub type. Sagebrush/Grassland and Desert Shrub vegetation dominate the area. At least 12 acres of Coniferous Woodland would be disturbed. Since most of these woodlands are in steep terrain, additional disturbance is likely to be needed to provide a safe working surface. This additional acreage would be addressed under a Temporary Use Permit.

About 36 acres of Riparian vegetation would be disturbed in the short-term. More than half of this disturbance is in Little Buffalo Creek, within the Little Buffalo Basin Field boundary, and along Gooseberry Creek. The remainder of Riparian vegetation disturbance is associated with ephemeral drainages. Disturbance in Little Buffalo Creek is primarily in a mixed herbaceous/shrub community. Disturbance in most of the Gooseberry Creek drainage is on terraces of Greasewood, except in locations where the pipeline crosses the creek. A cattail marsh, including areas of open water and willow, would be disturbed by the pipeline through the Gooseberry drainage. Rerouting the pipeline south of this agricultural pond would disturb more cropland. Rerouting to the north would disturb Desert Shrub vegetation, but would require two additional crossings of state route 431. The riparian vegetation of the Killifish Exclosure will not be disturbed.

An additional 819 acres of disturbance is estimated for replacement of producing and injection pipelines within the Little Buffalo Basin Field (see Table 1-2). Since the location of pipelines that would require replacement is not currently known, the impact on each vegetation type cannot be estimated at this time.

There are no threatened, endangered or proposed plant species in the vicinity of the Little Buffalo Basin CO_2 Project but Evert's Water Parsnip, a candidate species, is known from the vicinity of the pipeline. Since a plant survey has not been conducted for the pipeline right-of-way, sufficient information is not available to evaluate impacts of pipeline construction on this species. Before final authorization of the project, a survey, based on available location and habitat data, would be conducted for this species. If a conflict between the

plant and pipeline is identified, appropriate mitigation measures would be developed to assure that project construction would not adversely impact this candidate species.

3.5.2 Agriculture

Summary Table 3-3 indicates that about 26 acres of cropland will be disturbed. This includes 2.2 acres of prime farmland. Disturbance would include an additional 0.4 acre of prime farmland soil which is not currently being farmed. The total disturbance of cropland accounts for less than 0.1 of 1 percent of cropland in each county.

In addition to cropland directly disturbed by construction, productivity of adjacent cropland may be affected by limiting availability of irrigation water while diversion ditches are interrupted. This impact can be minimized if irrigators are given sufficient notification of construction schedules and repair of diversions is expedited. Revegetation of the ditch crossings will require special attention to prevent future erosion.

Since the Little Buffalo Basin CO_2 flood would be an immiscible flood, the amount of wellfield-produced water that is discharged to the surface and used by downstream irrigators should not change as a result of this project. It is assumed that both directly and indirectly affected landowners will be compensated for production loss due to the project construction.

An indirect impact on local agriculture may be in interruption of or delays to sugar beet hauling along Gooseberry Creek Road (state highway 431) in the fall.

Table 3-7 summarizes expected long- and short-term loss of forage due to construction and operation of the Little Buffalo Basin Project. About 154 AUMs would be lost for the short-term and only about 7 AUMs lost for the life of the plant and pipeline facilities (i.e., recycle plant, block valves, origin and meter stations). The total disturbance (long- and short-term) is greater than 1 percent of licensed forage on three allotments (#0594 (4%), #0564 (6%) and #2510 (10%)). The impact to these allotments is due primarily to replacement of production and injection pipeline within the Little Buffalo Basin Field. The impact on the stocking rates is also greater than 1 percent of current rates for these three allotments.

As proposed, the spur pipeline route disturbs one private livestock reservoir, i.e., the cattail marsh described in the vegetation section above. Significance of indirect effects on livestock watering will be mitigated by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone.

No field or farmstead windbreaks will be directly affected by project construction. Since the inmigrant workforce is relatively small compared to its anticipated place of residence (Worland), no conversion of cropland to other land uses as a result of urban expansion is expected (see the Socioeconomic Technical Report for a complete discussion).

Table 3-7. Estimated Short-Term and Long-Term Loss of Forage for the Little Buffalo Basin Spur Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Grass Creek	0508	7271	0.06	24.2 - 24.5	2.7	Origin station	0.1	4.66	0.01	4.66	0.06	<.01	0.06
				27.9 - 36.0	73.7								
				Road bore pits	1.1								
	0545	982	0.15	6.6 - 9.3	24.6			5.22		5.22	0.53		0.33
				10.2 - 11.2	9.1								
				Road bore pits	1.1								
	0564	562	0.23	2.4 - 2.5	0.9			32.23		32.23	5.74		5.74
				Wellfield (e)	139.2								
	0579	2316	0.15	9.3 - 10.2	8.2			3.14		3.14	0.14		0.07
				11.2 - 12.0	7.3								
				13.7 - 14.3	5.5								
	0594	567	0.17	0 - 0.6	5.5	Recycle plant	40.0	20.42	6.83	27.25	3.60	1.21	1.20
				Wellfield (e)	114.7	Meter station	0.2						
	0604	6600	0.12	14.8 - 18.1	30.0			3.74		3.74	0.06		0.03
				Road bore pits	1.1								
	0605	7778	0.12	0.6 - 2.4	16.4			48.70		48.70	0.63		0.37
				2.5 - 6.6	37.3								
				Wellfield (e)	352.2								
	2510	347	0.16	Wellfield (e)	212.9			34.070		34.07	9.82		9.82
	No allotment			12.0 - 13.7	15.5								
				14.3 - 14.8	4.6								
				18.1 - 21.2	28.2								
				22.2 - 24.2	18.2								
				24.5 - 27.9	30.9								
	Killifish Excl.			21.2 - 22.2	9.1								
	Unknown					Block valve (f)	0.1		0.02	0.02			
							TOTALS:	152.18	6.86	159.05			

a = Source: Mileages calculated from Vegetation maps LBB-1a through LBB-10 and BLM data. See also Table 2-9.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include block valves, station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide; assumes 43% of field in allotment #0605, 26% in allotment #2510, 17% in allotment #0564 and 14% in allotment #0594
f = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.24) was used to estimate forage loss.

3.6 SALT CREEK CO_2 PROJECT

3.6.1 Soils and Vegetation

About 126 acres would be disturbed in construction of the Salt Creek Project. Although steep areas are limited in the Salt Creek area, special attention to erosion control in them would limit accelerated erosion.

Most of the right-of-way soils have other limiting features, primarily shallow soil with low permeability. Although vegetation will be more difficult to establish on these soils, an annual precipitation in the area averaging 10 to 14 inches, should make revegetation feasible. Reclamation techniques which enhance permeability would increase the potential for successful revegetation.

Table 3-2 provides estimated acreage of each vegetation type to be disturbed by spur pipeline and recycle plant construction. About 85 acres will be temporarily disturbed and about 40 acres will be disturbed for the life of the project. Desert Shrub, the most common type in the vicinity, constitutes about 43 percent of the short-term disturbance and almost all of the long-term disturbance. While the spur pipeline does not cross any perennial creeks, it does cross Dugout Creek, a wide ephemeral draw. The area should not be crossed when the soils are saturated.

An additional 1,775 acres of disturbance is estimated for replacement of producing and injection pipelines within the Salt Creek Field (see Table 1-2). Replacement would be conducted over a period of four years. Since the location of pipelines that would require replacement is not currently known, the impact on each vegetation type cannot be estimated at this time.

The Salt Creek Project will not disturb any threatened, endangered or candidate plant species.

3.6.2 Agriculture

No cropland or field or farmstead windbreaks will be directly affected by project construction. Since the inmigrant workforce is relatively small compared to its anticipated place of residence (Casper), no conversion of cropland to other land uses as a result of urban expansion is expected (see the Socioeconomic Technical Report for a complete discussion).

Table 3-8 summarizes expected long- and short-term loss of forage due to construction and operation of the Salt Creek Project. About 235 AUMs would be lost for the short-term and only about 5 AUMs lost for the life of the plant and pipeline facilities (i.e., recycle plant, block valves, origin and meter stations). The short-term disturbance is about 3 percent of allotment #0154 and about 24 percent of allotment #0039. The latter is primarily due to replacement of production and injection pipelines within the Salt Creek Field. While replacement of these lines is expected to take four years, i.e., only one-quarter of the area disturbed each year, reclaimed areas cannot be expected to be available for full grazing pressure for at least a few years. The impact on the allotment stocking rates would be about 16 animals units, about 25 percent of the current rate.

Table 3-8. Estimated Short-Term and Long-Term Loss of Forage for the Salt Creek Spur Pipeline and CO2 Recycle Plant. (a)

Resource Area	Allotment Number	Licensed Range Forage (AUMs)	AUMs Per Acre	Short-Term Disturbance: Milepost or Facility (b)	Short-Term Disturbance: Acreage	Long-Term Disturbance: Milepost or Facility (c)	Long-Term Disturbance: Acreage	Forage Loss (AUMs): Short-Term	Forage Loss (AUMs): Long-Term	Forage Loss (AUMs): Total	Forage Loss (% of Total Licensed): Short-Term	Forage Loss (% of Total Licensed): Long-Term	Stocking Rate (d)
Platte River	SDW	5000	0.10	6.9 - 8.3	12.7	Meter station	0.2	1.67	0.02	1.69	0.03	0.00	0.00
				8.8 - 9.2	4.0								
	0039	760	0.13	0 - 1.8	16.4	Origin station	0.1	182.06	5.21	187.28	23.96	0.69	24.64
				Wellfield (e)	1384.1	Recycle plant	40.0						
	0115	848	0.02	1.8 - 2.7	8.2			3.00		3.00	0.35		0.35
				Wellfield (e)	141.96								
	0118	262	0.07	8.3 - 8.8	4.6			0.32		0.32	0.12		0.02
	0153	999	0.18	Wellfield (e)	248.43			44.72		44.72	4.48		1.49
	0154	111	0.08	2.7 - 6.9	38.2			3.15		3.15	2.83		0.47
				Road bore pits	1.1								
	Unknown					Block valve (f)	0.1		0.02	0.02			
							TOTALS:	234.92	5.25	240.16			

a = Source: Mileages calculated from Vegetation maps SC-1 through SC-5 and BLM data
See also Table 2-9.
b = Short-term disturbances include all construction that will be reclaimed upon completion.
c = Long-term disturbances include station, plant sites, etc. that will remain for the life of the project.
d = Percent change in stocking rate is calculated on a minimum stocking rate for each allotment, i.e., licensed AUMs divided by the longest period allowed for grazing in each allotment.
e = Acreage disturbed if all existing producing and injection pipelines are replaced; assumes a common trench 75' wide.
assumes 78% of the field in allotment #0039, 14% in allotment #0153 and 8% in allotment #0115
f = Since the block valve location has not been determined, the most productive allotment AUMs/acre (.18) was used to estimate forage loss.

No stock watering areas would be directly affected by construction. Significance of indirect effects will be mitigated by Amoco's efforts to prevent pipeline construction from limiting livestock access across the construction zone. Since the Salt Creek CO_2 flood would be an immiscible flood, the amount of wellfield-produced water that is discharged to the surface should not change.

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